ELECTRICAL CONSTRUCTION AND MAINTENANCE

With which is consolidated Electrical Contracting The Electragist and Electrical Record . . . Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installations, repairing, maintenance and management, in the field of electrical construction and maintenance.

December • 1948

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"Give us the tools . . ."

For High Wages, Full Employment . . . Business Must Have Better Tools *and More Money to Pay for Them*

So far we have escaped the post-war depression predicted by leading government economists. How can we continue to frustrate gloomy prophets who see only depression ahead?

At the end of World War II the federal Director of Reconversion saw depression immediately ahead. He said we would have 6,000,000 unemployed four months after VJ-Day and 8,000,000 a few months later.

But we did not have depression. We did not because:

First, the American business man, sensing the obligations of a vastly more important post-war America, went ahead to build his plant and equipment to meet expanding domestic and world markets—markets bigger actually and potentially, in terms of world-wide trade and profits than any previously envisaged.

Second, the American businessman was able to get the money to go ahead. Since 1945 he has spent $50 billion building new plants and buying new equipment.

There may be other reasons why we missed a depression in 1946. But—make no mistake about it—what has powered our present prosperity is the $50 billion spent by businessmen since VJ-Day to improve their plants.

It provided jobs directly for 5 million people. It paid for more than half of our record-breaking steel output. It put in place the foundations of great new industries such as television. It strengthened the foundations of the chemical, machinery, plastics, steel and oil industries. It has expanded and improved our power systems throughout the country.

This spending has made the difference between prosperity and slump, between industrial strength and serious deterioration.

In fact, we know now that what business spends for new plants and new tools always makes the difference between prosperity and slump, the difference between national strength and weakness.

The accompanying chart tells the story. When we have spent heavily for new plants and equipment, we have had prosperity and strength. When we have not, we have been in trouble.

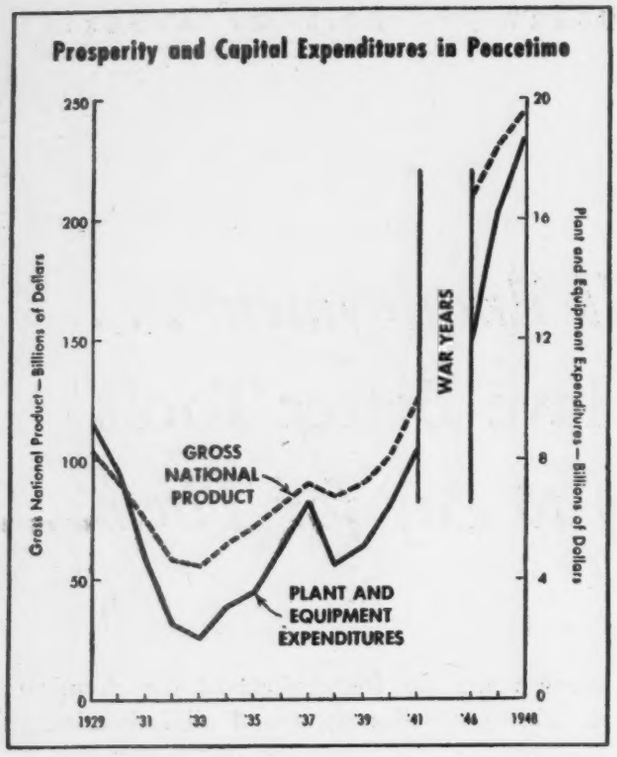
We would have been in trouble since VJ-Day except that business used its war reserves, plus two-thirds of its profits, plus borrowed money to improve and expand its facilities. This year industry is spending $19 billion this way.

Has this great post-war expansion actually made our economy a "mature economy"? Have we come now to the saturation point the New Dealers mistakenly said we had reached in the '30's?

The answer is no!

Proof of that answer is being developed through a McGraw-Hill national survey of "Business' Needs for New Plants and Equip-

continued on next page



ment" details of which will be given in this editorial series in coming months.

We have a bigger nation, more people, to serve right here at home. Further we must meet human needs which the war created around the world. Also, we must sustain a world position such as this country never assumed before.

Here are immediate things crying to be done.

1. Business still needs billions to expand production because our country and our needs are growing rapidly. Example: To meet the demand for power, electric utility companies must nearly double their present generating capacity in 10 years. That will cost more than $7.5 billion. To fill increasing needs for oil and gasoline, oil companies must spend at least as much.

2. Business still needs billions to get its plants up to date and overcome wear and tear. Examples: Over half a million of our freight cars, a third of the total, are more than a quarter of a century old. About two-thirds of the looms in the textile industry are more than 20 years old. Half of our coke ovens, basic equipment for iron and steel production, are more than 20 years old, and only half as efficient as modern ovens.

3. Business still needs many billions to do new things in dramatic new ways. Example: Machinery that will cut out 80% of the dirty, dangerous work of mining soft coal has been perfected. A new automobile engine plant will reduce the work that goes into engine-building by three-quarters.

Hundreds of similar things that our scientists and engineers have developed could be cited. They can be found in every industry. They hold immeasurable promise of adding to the abundance of American living. In fact, there is hardly a step along the whole route of industry—from roughing out raw materials to delivering finished goods—where there are not new and better ways of doing things standing ready for general use.

But the crucial question now is: Where is the money coming from to put to work these new and better ways of doing things?

Business has used its own resources so far... profits and reserves. The stock market, where industry traditionally has raised money from people willing to risk their savings, has been limping along, giving business no chance to get enough money on satisfactory terms. *Business now must look primarily to its own earnings for the money to carry out the improvements which are necessary if America is to keep itself strong and efficient.* The next editorial in this series will deal with this new and crucially-important role of profits.

But business can not count on profits alone to do the job. Profits are too uncertain.

From now on finding the money... to put new ideas and new equipment to work... to go ahead with the expansion and improvement that will thwart depression and build industrial strength . . . *calls for the support of all Americans everywhere.*

This comes right down to *you... for at stake is your chance for steady work, for better pay, for new things like television, and for more of the every-day things, like coal and clothing, of better quality and at less cost.*

By helping business get new and better tools, you will help yourself—and you will help build a more sound, more prosperous, better America.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

DECEMBER . . . . at a Glance

Cost Factors

Concluding his series of four articles on cost factors for cable selection and application, H. J. Finison discusses the selection of cable sizes in this installment. The tables include detailed curves for total cost of breakers and installed cost plus capitalized loss for cables in several arrangements. The article begins on page 62.

Balance

Vibration and wear of rotating parts in electrical machinery are important detriments to operation and to apparatus life. Unbalanced distribution of weight is the usual cause. Many types of equipment are now available to detect weight unbalance, both static and dynamic, in the shop. Industrial Editor Hugh Scott has brought together a round-up of methods and practices for balancing rotating electrical apparatus in "Dynamic Balance," beginning on page 60.

High Maintenance

Bissett Electric Company's installation of fluorescent lighting units on the 34-foot ceiling of the California State Capitol provides many interesting details around provisions for maintaining lighting on high ceilings. The methods used here are disconnecting hangers, lowering cables, and a portable winch. The story "Winch Maintenance for High Ceiling Lensed Fluorescents" begins on page 54.

Reports to Come

Heading off our big January issue are two features that bear on the months ahead. As we go to press, our folks are checking reservations and packing notebooks and cameras to cover the Florida NECA convention. The proceeds in pictures and story of the activities there will come to you next month.

And, as is our custom, we shall condense the findings and forecasts of the year end in our annual outlook for the electrical construction industry. Watch for these features in January.

Primary Loop

The great R. R. Donelly and Sons Company plant in Chicago handles some of the largest printing jobs in the country. Electrical reliability is of the utmost necessity in scheduling these tremendous operations. Harry A. Garn of Albert Kahn, Associated Architects and Engineers, tells us the story of a dual primary distribution system to insure electrical reliability, installed by Edward Electric Company. You'll find the article "Primary Loop Serves Printing Plant" on page 51.

Apartment Wiring Methods

Multi family dwellings of substantial size are beginning to appear in the construction programs of our big cities. Wiring practices in modern apartment buildings are always an important indication of residential wiring trends. Marshall Ledwick of the Marshall Electric Corporation of New York City, gives us a round-up of typical electrical construction and wiring techniques in modern New York City apartment buildings. The story, "Apartment House Wiring" will be found on page 56.

Correction

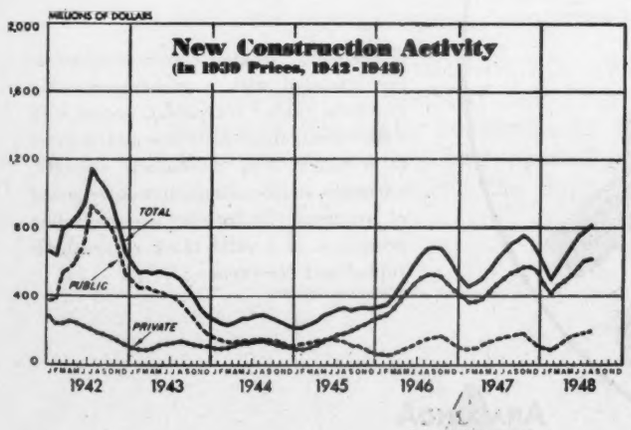
Harry A. Johnson of Westinghouse Electric Corporation in San Francisco calls our attention to a formula and an example in the article, "Test Method for Three Phase Motors" by A. F. Stilson in the October issue. The formula should have been:

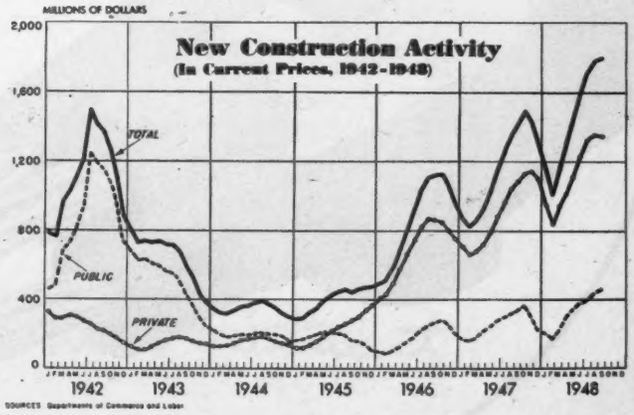
$$I = \frac{\text{Watts}}{1.73 \times \text{Volts} \times \text{P.F.}}$$

The example:

$$I = \frac{7200}{1.73 \times 220 \times .74} = 25.5 \text{ amperes.}$$

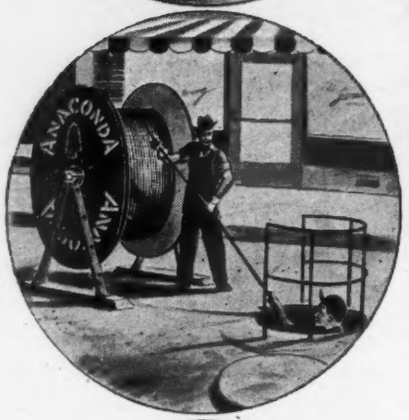
We and the author are grateful to Mr. Johnson for calling this to our attention.

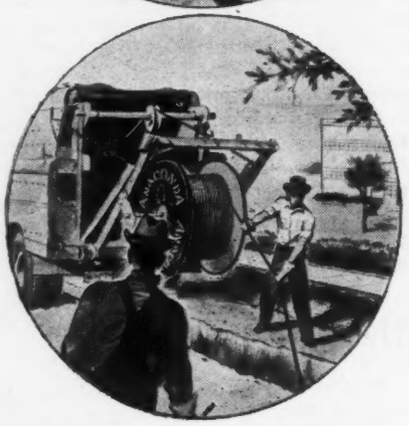




PICK ANY SPOT... THEN PICK

Durasheath





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*Reg. U. S. Pat. Off.

ANACONDA
from mine to consumer

POWER OF CHOICE

THE PAST YEAR has witnessed an increasing flow of new products and devices into the electrical construction field. And in some more conventional lines war and postwar shortages have eased substantially. For the first time in many years a purchase order can specify quantity, brand and catalog number with practical assurance that it will be filled as written in reasonable time.

MORE MATERIALS and a prosperous outlook are restoring to electrical construction men a tremendously powerful instrument—the power of choice. Used with deliberate wisdom, it can inspire progress, create new markets and build a strong, expanding industry. Ignored, exploited for narrow advantage, or delegated to avoid responsibility, it can be equally destructive.

INDUSTRY PROGRESS or decline is written in orders. A product of years of laboratory development backed by generations of responsibile manufacturing or a gadget from a mushroom loft shop are both waiting for the returns from the marketplace. And the preponderance of purchases will determine in which direction more development and initiative will be pushed. Choice expressed by orders will decide.

BUYING BY PRICE ALONE is almost never a measure of intelligent choice. Plain price provides an insidiously simple formula requiring no special knowledge, understanding or experience in application. It is rarely constructive. It may have some usefulness as a temporary means of survival in desperate competition. But it has no place in a healthy, progressive industry in a normally prosperous economic environment.

PRICE BECOMES a compelling factor in choice only when values have been weighed skillfully. Some values are obvious, others could be disclosed to the inexperienced buyer only by costly analysis. And some are entirely intangible. Two contact surfaces may look alike and yet be of greatly different quality. Two products may be substantially alike in function yet represent company background and industry policies that are poles apart.

THE POWER OF CHOICE must logically be exercised by those with the experience and skill to appreciate value. Electrical work is a complex of many technical materials and values are not always intrinsic. The wise selection of materials is an important area for expressing the policies, standards and efficiency of an electrical contracting organization, as well as making and keeping a reputation. And in the long run, it expresses the policies of an industry.

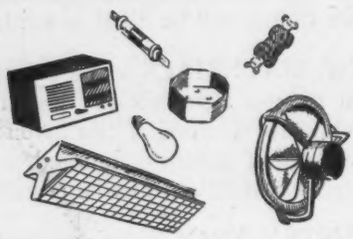
EXPERIENCED AND ABLE material selection invites full responsibility—responsibility that looks beyond the "fast buck" and the sharp advantage. Guarantee commitments, established reputation and creative market development can only be supported on a strong foundation of sound, practical values. And sound values can come only from the consistently wise use of the power of choice.

Wm. F. Stuart

You say you don't buy 'em from Graybar?"

"Then maybe I can save you quite a bit of time and expense! Hundreds of electrical contractors already are saving — by buying their needs from us. For wiring, lighting, 'intercom' systems — just about any job . . .

"First reason is, you can get 100,000 different electrical items — just by picking up your phone and calling Graybar's local office! Ordering everything from Graybar saves you time — for construction or maintenance . . .



"And it's all quality stuff — carefully selected over the years by men who know the business in each field. Graybar's lines are the nation's favorites — products of leading manufacturers. Names you have confidence in . . .

"Whenever you need special technical assistance, one of the Graybar Specialists goes to work on your problem. Meanwhile, as your regular Graybar Representative, I can give you quick facts on any electrical items . . .

"One nice thing about doing business with Graybar is—we're a friendly bunch. Our local people take a real interest in their neighbors and customers. Yet you get the benefits of our nation-wide set-up and experience . . .

"Graybar is fussy about the people it hires. That goes for the folks behind the scenes, too — like our order editors. Our clerks are accurate. Our warehousemen know how to pack your stuff and get it delivered on time! . . .

"The fact that Graybar is the oldest and biggest distributor of electrical supplies may not set you on fire. But our long-time, close relations with leading suppliers don't hurt a bit — especially when you need unusual help . . .

"One thing about Graybar that really makes us different . . . we're 100% owned by ourselves — operating and retired personnel. That makes us especially anxious to please. Gives you the kind of attention you want! . . .

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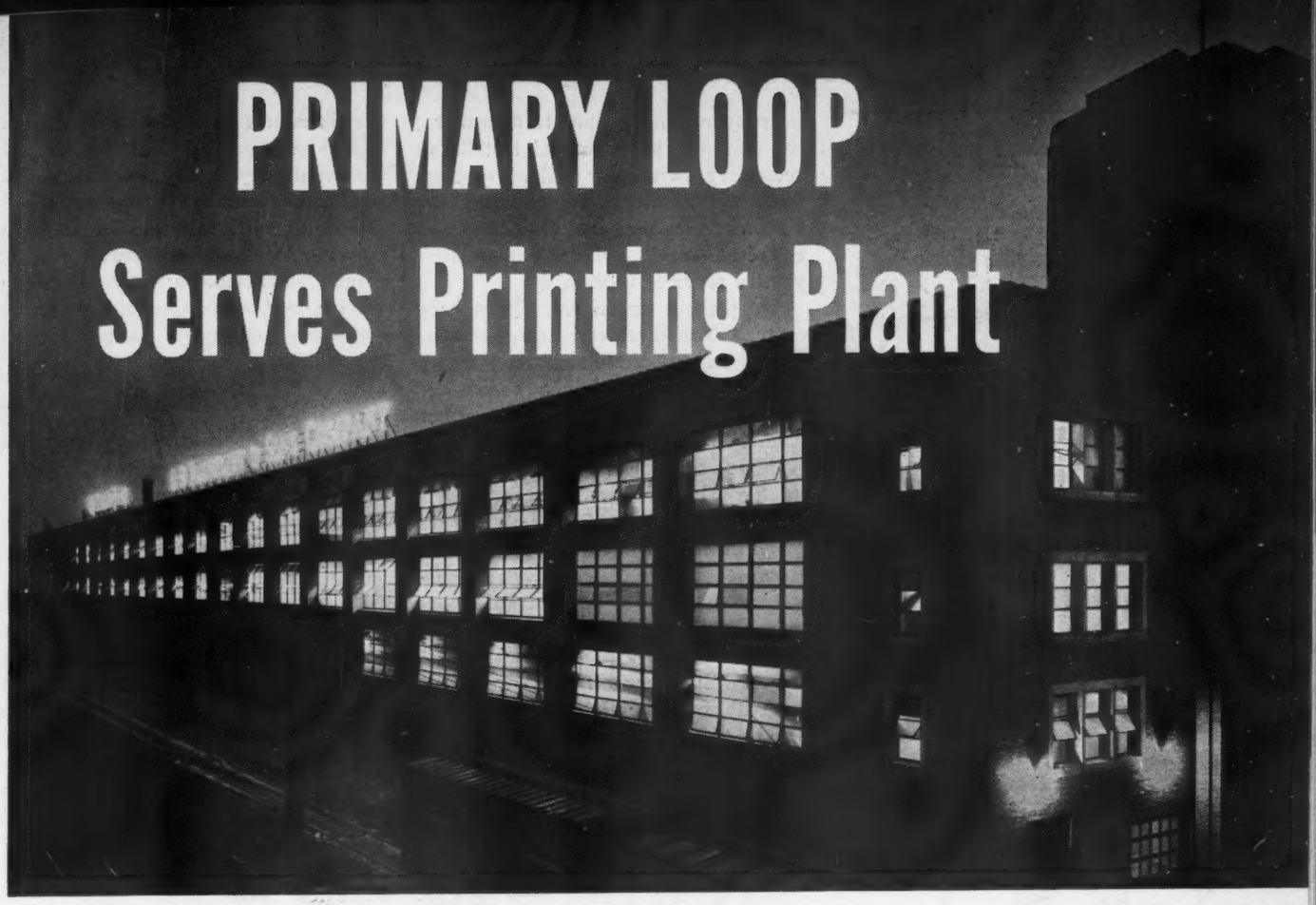
PRIMARY LOOP Serves Printing Plant



Dual primary distribution provides service reliability at the modern printing plant of the R. R. Donnelley & Sons Company in Chicago. Feeders are normally supplied by two transformers operating in parallel. Installation by the Edward Electric Company, Chicago.

By Harry R. Garn

Electrical Engineer
Albert Kahn Associated Architects and Engineers, Inc.
Detroit, Michigan.

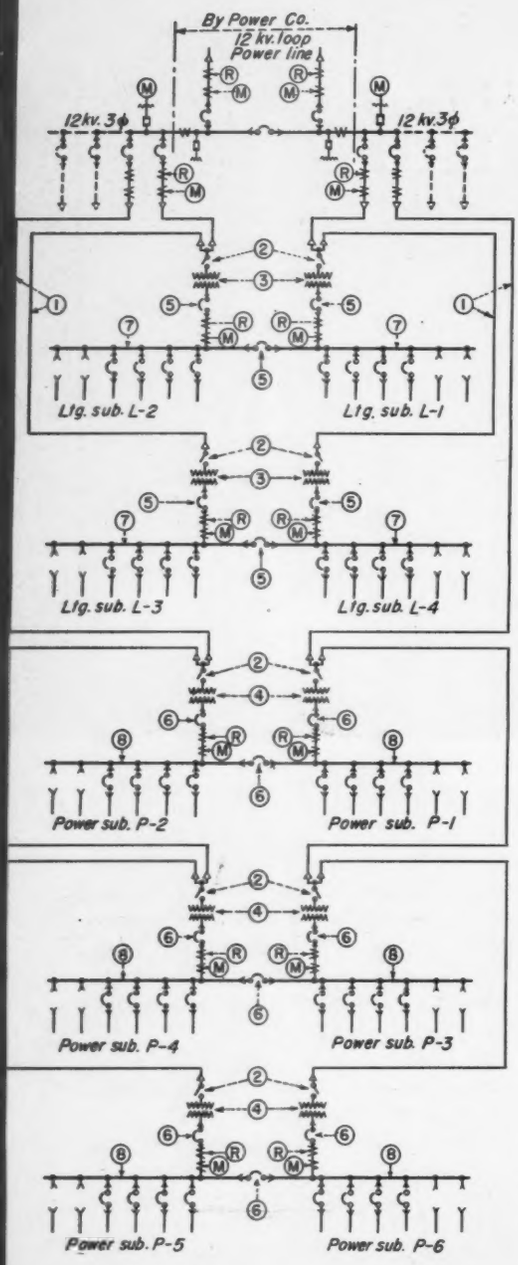
AS you read this article, or any newspaper or magazine story, are you aware of the "behind the scenes" activity necessary to meet the deadline? Of the tremendous manpower and machine-power that backs up each issue? Today's speed of news dispatch involves high-speed mechanized printing, binding and delivery techniques, all dependent upon precision-operated motor-driven machines. Behind these well organized materials flow and production schemes is a reliable electrical system that must provide service continuity during outages and emergencies.

Such was the basic philosophy behind the electrical distribution system in the new printing plant of the R. R. Donnelley & Sons Company in Chicago. Designed by Albert Kahn Associated Architects and Engineers, Detroit, the three-story structure provides some 560,000 square feet of floor space for additional press and bindery operations. General contractor was the Peter Hamlin Construction Co.; electrical contractor, The Edward Electric Co., both of Chicago.

Service reliability for the plant required the design of a dual system of primary distribution with all feeders normally supplied by two transformers operating in parallel. Power and light feeders will not be interrupted by the failure of any transformer or primary feeder. Loads can be transferred from one transformer to another without a moment's interruption of the power supply.

Electrical service is supplied by the Commonwealth Edison Company via a 12-kv. loop power line providing a dual feeder system from the power company's substation to the customers' 12-kv. buses. Normally, the complete loop is closed and power flows over both halves of the loop into 12-kv. buses in each customer's vault. Each loop section is equipped with breakers having differential protection. A cable failure on any section of the loop will automatically open the breakers on the faulty section and complete an annunciator circuit which is relayed to the power company. Although a cable failure will sectionalize the loop, all customers will continue to receive power over the other half.

Secondary service for large industrial customers is still being recommended by many power companies. When supplied, the power company furnishes, installs and maintains all



① No. 1/0-3 conductor, P. & L. cable (15 kv.)

② 200 amp., 3 pole, 15 kv., air filled, load break disconnect switch. (Key interlocked with main secondary breaker)

③ 300 kva, 12 kv. to 208/120 volt, 3 phase, 4 wire, dry type transformer

④ 750 kva., 12 kv./240 volt, 3 phase dry type transformer

⑤ 1,000 amp., 600 volt, 3 pole, manually operated air circuit breaker

⑥ 2,000 amp., 600 volt, 3 pole, electrically operated air circuit breaker

⑦ 208/120 volt, 3 phase, 4 wire bus

⑧ 240 volt, 3 phase bus

FIG. 1—One line diagram showing primary loop distribution with dual transformer service to secondary radial feeder system.

primary switch-gear and transformers; the customer provides and installs all secondary switchgear and low-voltage feeders. Transformer vaults, within the customer's building are required in all congested areas where only underground service is available.

By placing transformers near the customer's load centers, voltage regulation is improved and secondary feeder investment reduced. In many instances this means two or more transformer vaults. Where more than one vault is required, the power company charges for the excess service facilities including additional monthly rental charges for extra transformers and switchgear. Because of this, many industrial customers have one large transformer vault and very long secondary feeders. Power company switchgear and transformer vaults are often located along one side of the building to hold primary service to a minimum length and facilitate moving transformers into the building. Such a plan frequently requires longer secondary feeders.

Primary service is ruled out of many projects because plant engineers feel that a specially trained crew of electricians would be required to safely operate and maintain primary equipment. However, high-voltage metal-clad switchgear having draw-out breakers, totally enclosed buses and gang operated disconnects equipped with key interlocks can be safely operated by any plant electrician. When the breaker is withdrawn from the structure an automatic shutter closes the openings in front of the primary disconnects. All breakers are serviced and test operated outside the structure where they are completely divorced from any high-voltage connections. It is a fact that this equipment is safer to maintain than ordinary low-voltage motor starters. Where high-voltage, metal-clad, air-circuit breakers and dry-type transformers are used, all operating and maintenance requirements are handled by the regular staff of plant electricians.

Where the power company's service is less than 15-*kv, that voltage should be used as the primary distribution voltage for the plant and run directly to substations located near load centers. For any building longer than* 400 *to* 450 *feet, it is not economical to distribute power at utilization voltage from only one substation.*

A cost analysis was made of Secondary vs. Primary distribution from the service entrance to two substation vaults in the basement areas of the Donnelley building. It was found that the difference in cost between a secondary and primary distribution system would pay for the customer's portion of the primary switchgear, primary ducts and cables and for all the power and light transformers. Also, primary distribution provides better voltage regulation, flexibility, service continuity, efficiency, simplicity and low maintenance.

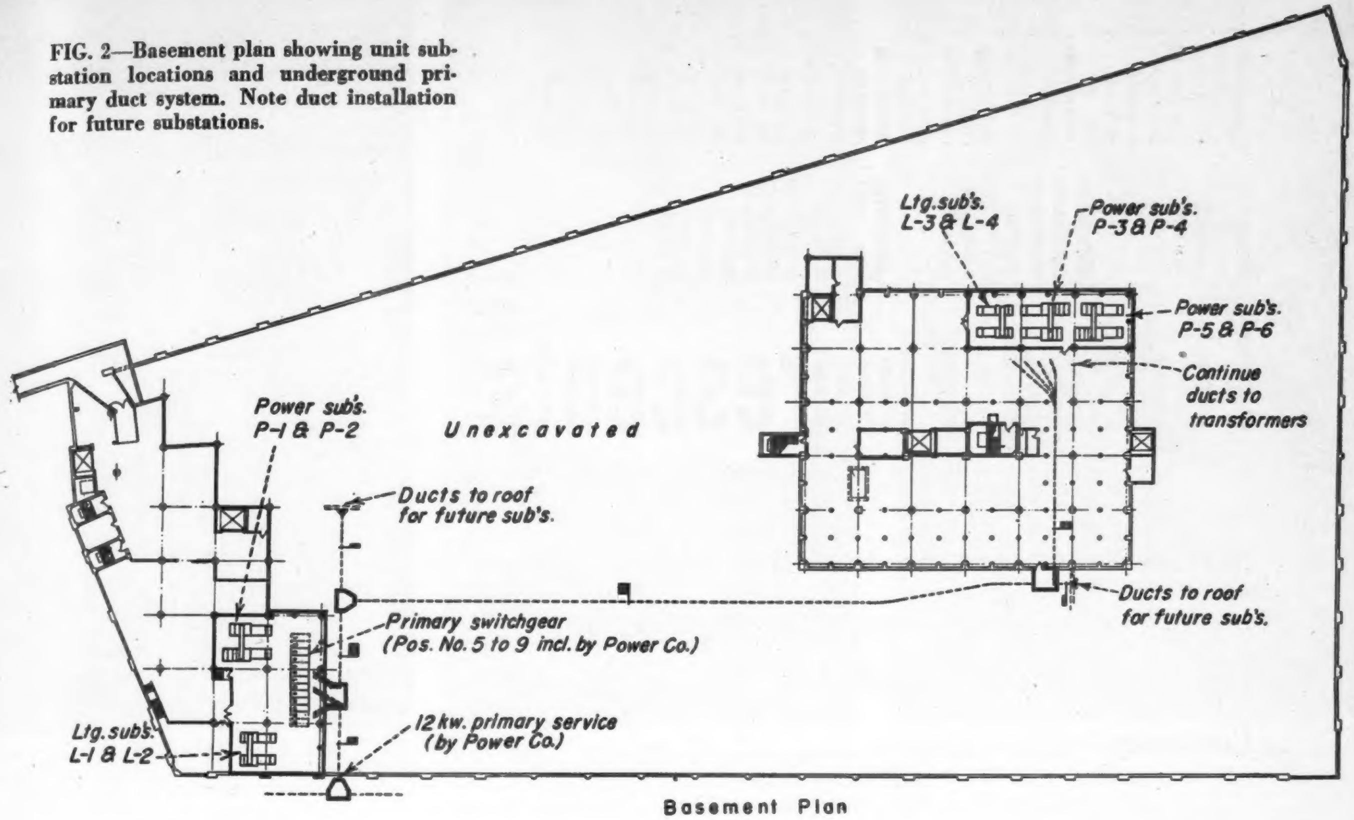
Primary Loop Distribution

Metal-clad switchgear, equipped with draw-out type, air circuit breakers having a 3-phase interrupting rating of 250,000 kva. and designed for 15-kv. grounded-neutral service, controls Primary service. *The power company's portion consisting of one tie and two incoming line breakers and two metering cubicles, was installed in the same vault and in the same line-up with the customer's primary switchgear.* Locks on the doors of the power company's metal-clad switchgear restricts operation and maintenance to power company personnel. This arrangement eliminates a separate utility vault and reduces customer investment since less floor space is required and both use the same equipment and access doors. Unit substations for power and light (each substation having dual transformer feeds) are located in the same vault with the Primary switchgear.

The customer's portion of the Primary switchgear consists of one lighting and one power feeder breaker on both ends of the utility switchgear. The switchgear is electrically operated by a 60-cell battery which is kept fully charged by a "Rectomatic" battery charger. The customer's breakers are

TWO UNIT SUBSTATIONS for power located in primary switchgear room. Primary breaker and transformer are in foreground; secondary cubicles in rear.

FIG. 2—Basement plan showing unit substation locations and underground primary duct system. Note duct installation for future substations.



equipped with indicating ammeter, watt-meter, and var-meter. Each bus section has a single-phase volt-meter with 3-phase transfer switch.

The building was designed for future addition of three floors. The primary switchgear has been designed and spare ducts have been installed up to the present roof to accommodate new primary breakers and feeder cables for future load center substations above the present roof.

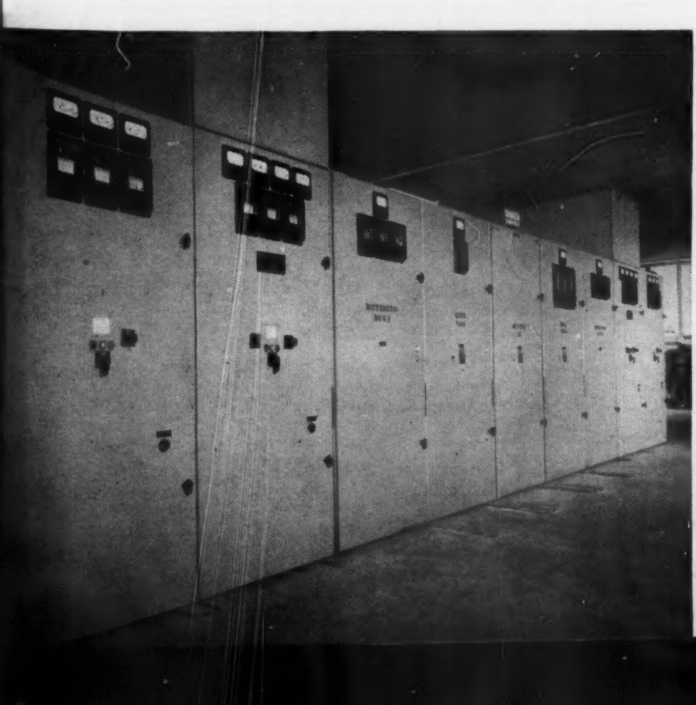
Each primary feeder for lighting is looped to two lighting transformers; and each primary power feeder is looped to three power transformers (See Fig. 1.). The 12-kv. tie breaker can be opened and service interrupted on one of the utility's incoming 12-kv. lines without service interruption to any of the secondary power and light feeders, *because one transformer on each dual substation will continue to feed all of the loads which were normally fed by the two transformers operating in parallel.*

All power and light transformers are 3-phase, dry-type, self-cooled. Dry-type transformers are capable of carrying heavier overloads than the conventional oil or "Askarel" insulated transformers and do not require floor drains. Since the transformers and primary and secondary switchgear contain no oil or other combustible material, there can be no fire hazard. A 4-speed fan supplies air to each transformer vault. Fans are equipped with filters to prevent paper lint and ink dust from entering switchgear vaults.

Primary service connection to each transformer is made through a 200-ampere, three-phase, gang-operated, totally-enclosed "De-ion" load inter-

[Continued on page 134]

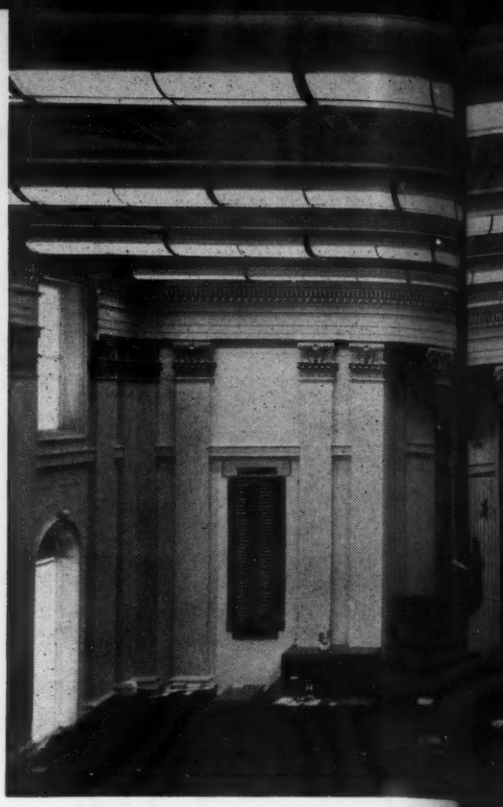
PRIMARY SWITCHGEAR is in same room with two unit substations. Incoming service, bus tie and metering cubicles are in center; customer's primary feeder breakers at each end.



SIX UNIT SUBSTATIONS in a single vault. Two in foreground are for lighting; four in rear for power. Note secondary bus tie between opposite units.

Winch Maintenance For High Ceiling Lensed Fluorescents

Surface fluorescent installation on 34 foot ceiling has prismatic lenses, winch lowering for lamping and maintenance, installed by Bissett Electric Company.

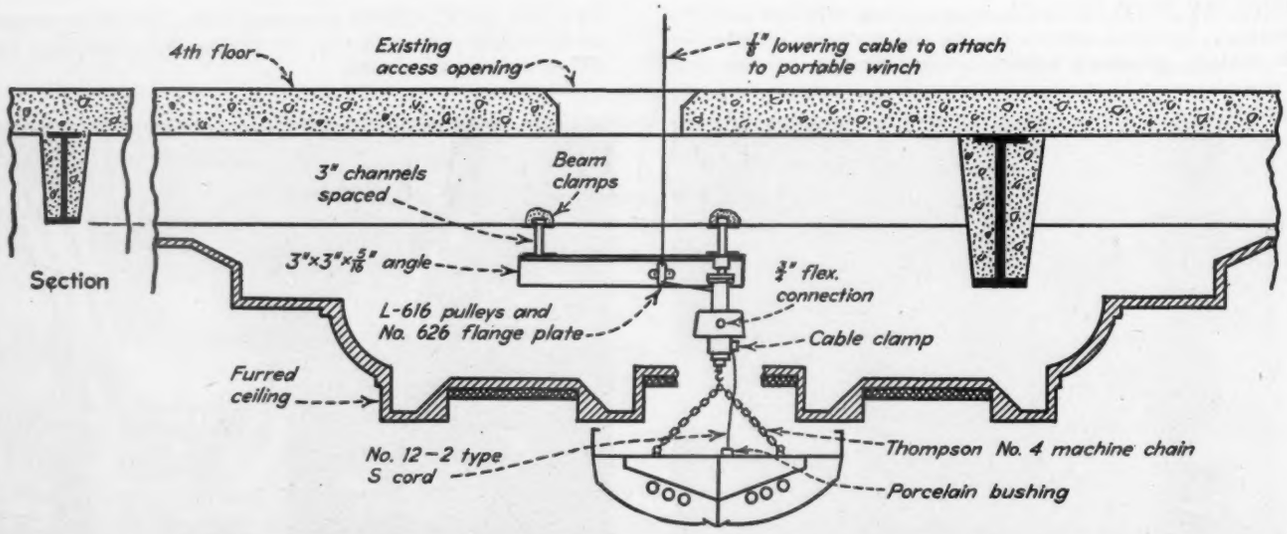


HIGH-BAY FLUORESCENT lighting on 34-ft. ceiling of California legislative as-

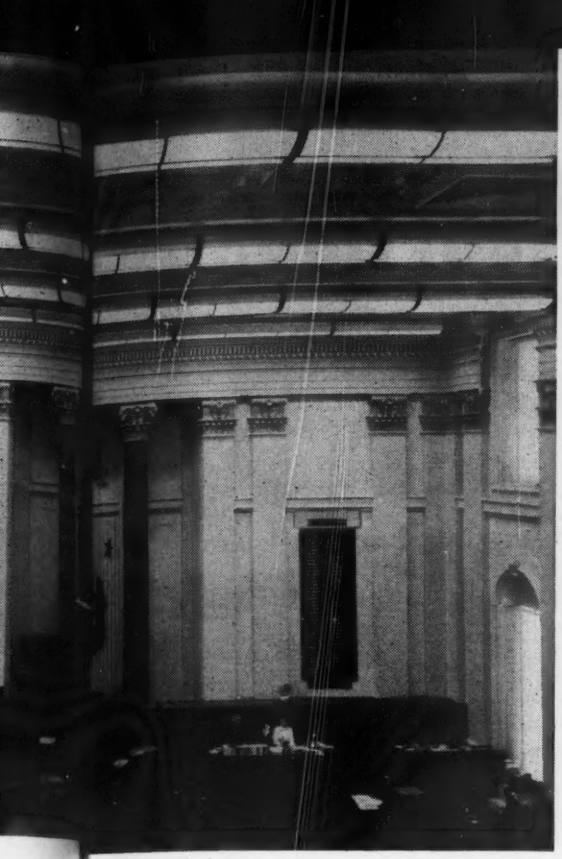
ONE of the first highly effective West Coast applications of fluorescent lighting fixtures directly on the ceiling of a high ceiling room is that in the legislative chamber of the California state capitol building at Sacramento. Relighting of the immense room with a 34-ft. ceiling was a part of a recent modernization program including the very latest in automatic vote recording apparatus and a public address system with microphones at each legislator's desk. Bissett Electric Company of Sacramento was the electrical contractor.

Old lighting consisted of twelve incandescent chandeliers, nine with 5 kw. each and three with 250 watts each. Lighting was poor from the unsightly fixtures and the heating problem never had been entirely satisfactorily solved. The new fluorescent installation consists of six rows of units mounted directly on the ceiling, as shown. Five rows are at the 34 ft. level and one row under the balcony. The three middle rows consist of eight fixture units each. Units are eight feet long with twelve Type F. 40 watt fluorescent lamps. First and last rows have two 8 foot and four 12 foot units with half the cross section of the center units. The under balcony row is similar but differently spaced. Punching the light to desks over 30 ft. below is the design of the semi-circular unit with special Holophane "controlens". Curved lens panels are hinged to permit access to the fixtures inside that hold the tubes.

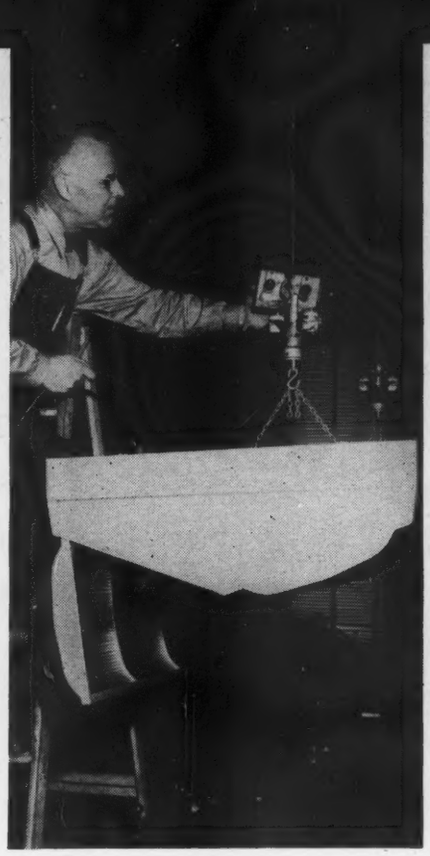
Such an installation on the ceiling was only made possible by use of Thompson hangers. These contact-making hangers permit 12-lamp sections of the heavy fixtures to be lowered to the floor for maintenance. A por-



MOUNTING DETAIL of the high ceiling units with disconnecting hangers and drop cable.



sembly room provides 50-60 footcandles through use of prismatic lenses.



FIXTURE LOWERED to floor for maintenance. Portable receptacle placed over contacts provides current for testing.

WINCHES RAISE and lower fixtures. Telephone communication is provided with man on floor for control.

table winch placed over manholes in the floor of the fourth floor of the building is used for this maintenance work. An upward pull and then a quick drop disengages the hangers and the fixture is then lowered as illustrated. With a cable on each end of the long heavy fixture it was found necessary to provide telephone communication between a man on the floor and one at the winch to control lowering and positioning of units.

Another problem, that of having some way of testing the units on the floor after tube replacement, was solved by use of a receptacle on a portable cord, as shown. This receptacle is the same as the contact-making part of the receptacle at the ceiling.

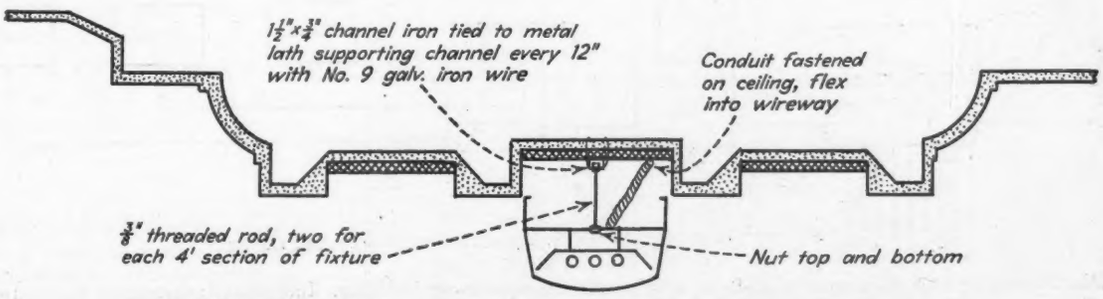
Ten manhole openings provide access to the supporting cables. Four existing 1½ inch conduits carry the branch circuits. Old wiring was removed and new No. 8 branch circuits installed.

The existing panel cabinet for the ceiling lights was 41 by 30 by 8 inches. Two new 16 circuit panels with 20 ampere single pole circuit breakers arranged for 3 phase 4 wire feed were installed. Feeders were extended to the main lugs of one section. An electrically operated, mechanically held 100 ampere 3 pole contactor controls the other section. This array, with new trim and doors, fitted easily into the existing cabinet. An existing 20 circuit panel was abandoned and the circuits extended to the above panel.

Hangers were wired in flexible conduit from pull boxes in the 1½ inch conduit runs, paralleling the fixture rows. Generally two 12 lamp units are connected on one 20 ampere circuit. No. 8 wire and common neutral home runs are used to minimize voltage drop on the relatively long runs.

Overall effect of this well-designed installation is to enhance the beauty of the room while at the same time delivering 50-60 footcandles of non-glare lighting at desk level. The design of the modern lighting system harmonizes effectively with the architecture of this historic old legislative hall.

Of equal importance from the standpoint of installation and maintenance is the use of lowering hangers which permits floor level cleaning and lamping. Much of the problem of high bay fluorescent installation is that of providing appropriate and convenient facilities for routine care. With lowering hangers the fixture design can take advantage of many of the more advanced illumination control techniques without incurring prohibitive maintenance costs or rapid deterioration in light output and efficiency.



OVER-BALCONY UNITS are suspended from channel tied to metal lathe supports.

Apartment

Typical electrical construction and wiring techniques used in New York City apartment buildings.

FIG. 1—Branch feeders rise from tenant meter panels in basement to second floor, where they fan out to separate vertical riser locations. Note outlet boxes in place for wall receptacles for second floor apartments.

POSTWAR housing construction has lagged in New York City as elsewhere in the nation. Multi-family projects totalling some hundred million dollars in value have been planned, but shelved. The reported reason is that construction costs have approximately doubled over prewar prices.

It is estimated that Manhattan could absorb some 75,000 to 100,000 new apartments, but in the face of this demand housing investors have gone on a buyer's strike. Investment returns from rental projects will not justify present day building costs. These conditions, however, have spurred on one type of housing construction in Manhattan—"cooperative" apartments.

Eleven luxury-type "cooperative" apartments, requiring purchase of stock for ownership by the tenants, have been completed or are well under way to completion. The electrical wiring and facilities is similar in each of these projects, with only minor variations. The wiring system and installation techniques described here were used in the new apartments at Madison Avenue and 74th Street, Sam Minskoff, Builder, and Sylvan Bein, Architect, and at 300 East 57th Street, Sam Rudin, Builder, and Emery Roth & Sons, Architect.

Electrical service supplied by the utility in Manhattan is generally three-phase four-wire 120/208 volt. The utility company requires that all meters be placed in a basement meter room on multi-family units. For buildings more than ten stories high the most economical type of distribution is generally provided by grouping adjacent apartments on a three-phase four-wire feeder, with a separate feeder running to each group of three apartments. Three single-phase two-wire meters are used on each four-wire feeder to each group of three apartments.

The New York City Code requires the electrical contractor to file with his application for inspection the following feeder data:

1. Area in square feet
2. Load (before applying demand factor)
3. Required demand-factor load (after applying demand factors)
4. Size of the conductors

The City Code also requires that the voltage drop from service point to the final distribution panel shall not exceed two and one-half percent. Feeder load is required to be calculated at two watts per sq. ft. of area, plus 1500 watts appliance load per apartment. Demand factors required are identical with the National Electrical Code. As the most economical distribution system installation is one in which three apartments are fed by one four-wire feeder, the area of all three apartments is used to calculate the feeder size.

Shown in Fig. 5 is a typical electrical layout for a typical apartment unit in

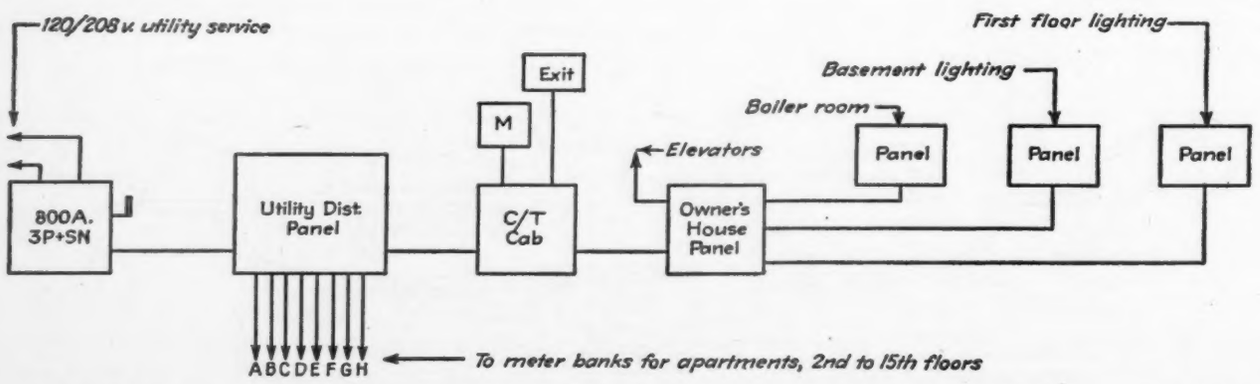


FIG. 2—Distribution system diagram for 15-floor and penthouse apartment building. Individual apartments are metered separately in basement meter room.

House Wiring

By Marshall V. Ledwick
Marshall Electric Corporation
New York City

the building at Madison Avenue and 74th Street, New York City. The cut-out panel (A) for this apartment is located in the kitchen wall which separates this apartment from the one adjacent, fed from cut-out panel (B). These cut-out panels are shown in place in Fig. 4, as well as the feeders for upper apartments, shown during the construction stage and before the wall was installed. Branch circuits average from four to six per apartment, depending upon size of apartment.

The individual metering of apartments in a basement meter room means that a large number of four-wire feeders are run from the meter room up to the individual three-apartment groups. General practice is to run these feeders vertically from the basement to the second floor, and to then branch out these feeders across the second floor to vertical risers which extend up to the individual apartment groups. Fig. 1 shows these feeders fanning out across the second floor from a common point directly above the basement meter room.

The electrical distribution system for the entire apartment building is shown in Fig. 2. It will be noted that exit lights, stair and hall lighting, all first floor and basement lighting, elevators, boiler room, etc., are metered separately on one meter for the building. Provision is also made for supplying individual electrical service as required to shops and stores which are located on the first floor, or street level.

Other electrical facilities in cooperative apartments include a complete house telephone system, a complete public telephone system, and a complete radio system. The radio system includes roof aerials, radio plugs in each apartment, and a ground. Coaxial cable is used from the second floor to the roof, with one No. 18 AWG wire to ground. Some of the recently completed apartment buildings have also been equipped with special AM, FM and television outlets in each apartment, using improved master television antenna systems.

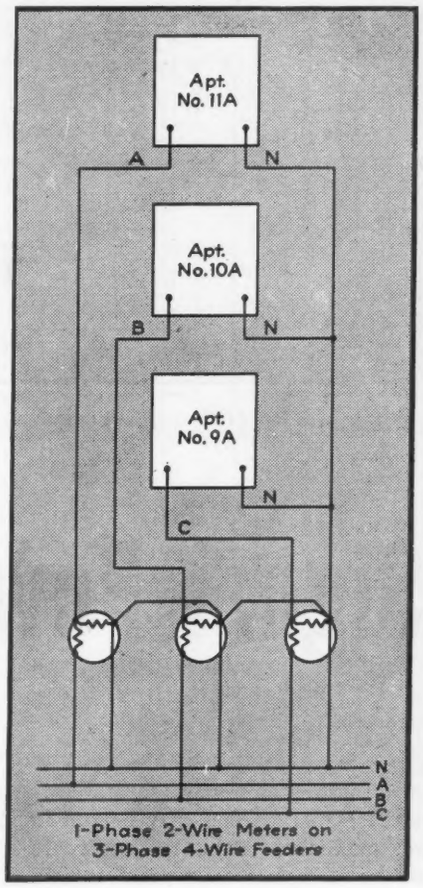


FIG. 3—Apartments are divided into groups of three for single-phase metering from 120/208 volt three-phase four-wire feeder service.

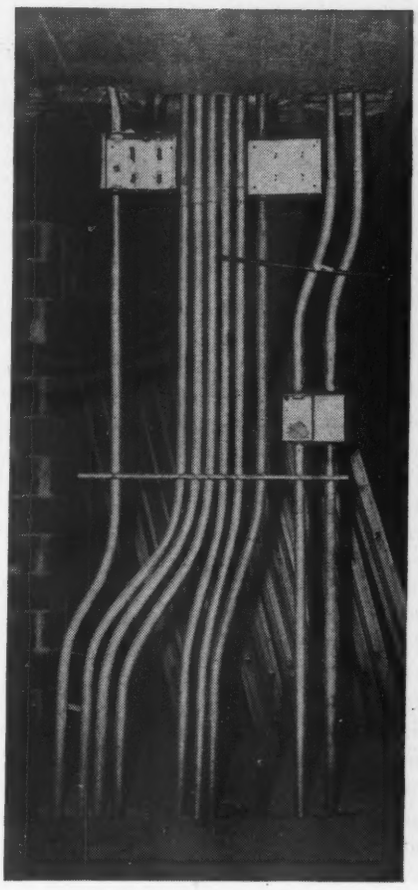


FIG. 4—Individual apartment panels are located in kitchen wall dividing two apartments. Feeders for upper apartments are also shown.

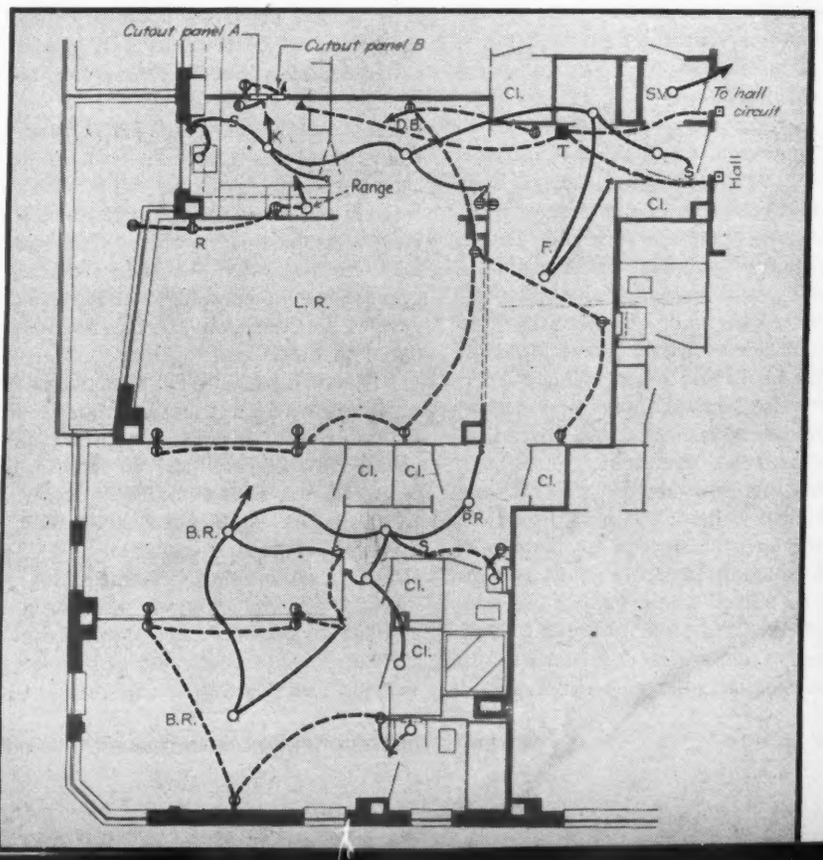
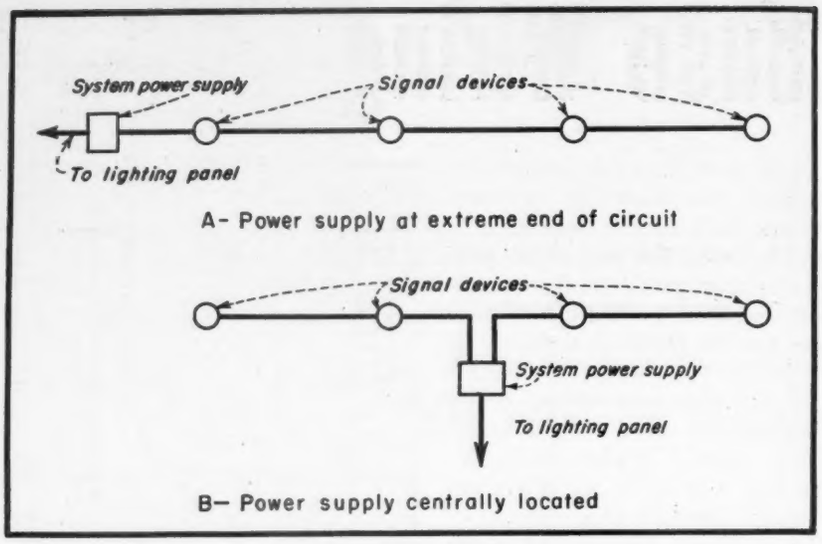


FIG. 5—Wiring layout for a typical apartment. The number of circuits per apartment is controlled by the square foot area at two and one-half watts per square foot, plus 1500 watts for an appliance circuit.

Signal Power Supply

By A. A. Schuhler



LOCATION of power supply should be near the load center.

THE selection of the correct and most economical voltage, power supply and wiring for any signal system is a fundamental requirement. There is no advantage and certainly no saving in the equipment or labor when sub-standard procedures are followed. Very often incorrect methods result in continuous trouble, interruptions and failures in the system which cause inconvenience and are costly to all concerned.

Most of the problems and questions which arise are those relating to the low-voltage systems, that is, up to and including 24 volts either alternating or direct current. This is because there are a number of critical factors involved such as the low-voltage, line drop, contact resistance, capacity or size and location of a transformer or other source of current, and the size of the conductors to carry a load over a specified distance. Whereas, in the higher voltages such as 115 or 230, the problems are greatly simplified, and furthermore, every electrical contractor is familiar with them as they are constantly working with these voltages in connection with lighting and power circuits and appliances.

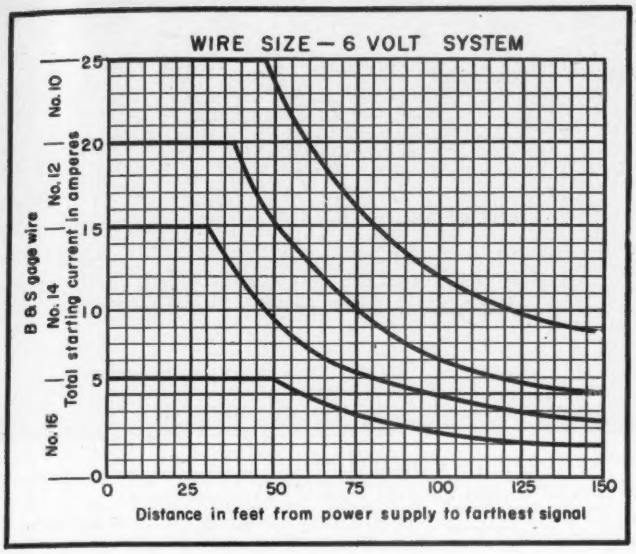
Standard voltages should be selected for the operation of signaling devices whenever possible, since they are readily obtainable and in most cases are lower in cost than specially wound apparatus. The standard voltages for alternating current units are 24, 115 and 230. The standard voltages for direct current units are 6-9, 24, 115 and 220-250.

In industrial work, the inclination is toward the use of higher voltages such as 115 alternating or direct current because it is generally available and is particularly suitable on long runs. Where this voltage is not available 230 volts may be used. These voltages require smaller wire sizes and eliminate transformers and other voltage reducing devices. Installation of conductors for these systems must be in accordance with the requirements of lighting circuits as specified by the National Electrical Code or the local ordinances having jurisdiction.

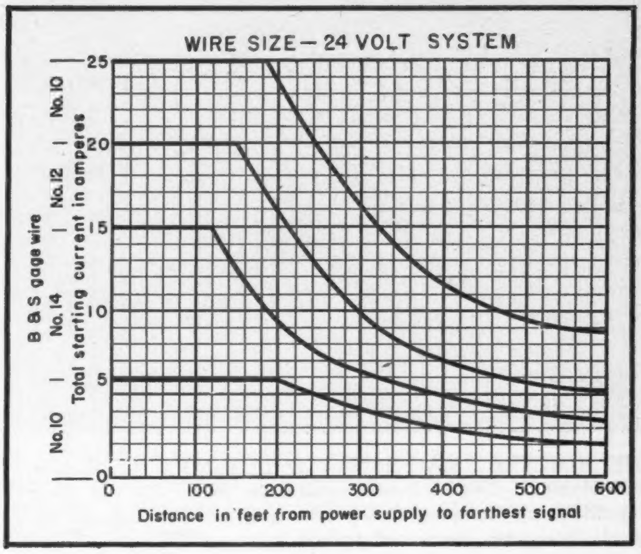
In small alternating current systems, and in others where 115 or 230 volts cannot be used possibly because of existing wiring which does not conform to the higher voltage requirements, 24 volts is recommended. This is likewise true of installations where several low-voltage signal systems may be run in the same conduit, and in systems where persons come into direct contact with pushbuttons at frequent intervals, such as in nurses call systems. The use of this voltage on alternating current is preferable because signaling transformers have been standardized upon and their outputs are based upon this voltage. If 12 volts were used it would either require a special transformer, or an oversized standard transformer, in which case only half of the capacity would be used and the other half would be wasted since it would not be used. In addition, the effect of line drop, contact resistance and other electrical losses in the system would be twice as great and of proportionately even greater detriment on 12 volts as compared to the 24 volt systems.

In small direct current systems, and in others where 115 or 220 volts cannot be used for the reasons outlined in the above paragraph, 24 volts is also recommended. Sources of direct current are the storage battery and the rectifier. The former insures isolation and reliable operation when combined with a charging rectifier having the trickle and booster features and connected continuously to the commercial power supply. The rectifier is also connected to the commercial power supply, however, it is subject to interruption should the power fail. A rectifier may be arranged to normally operate a system, and when a failure in current supply occurs, a relay may be used to transfer a storage battery to the system to insure continuity of operation. Where only a few small signal devices are to be used, and the length of the runs are very short, and the service is intermittent, 6-9 volts may be used. Current supply for such a system may be derived from dry cells or a small rectifier. Dry cells require replacement and are not recommended in the larger systems.

Signaling devices should be operated at their rated voltages for the best performance. The various units such as bells, buzzers and horns are generally designed and adjusted to operate over a considerable range of voltages. This is in accordance with the Underwriters Laboratories requirements which covers a range of 80 to 110 percent of the rated nameplate voltage. As an example, a 115 volt signal will function as low as approximately 90 volts and as high as 126 volts without damage. A 24 volt unit will operate throughout a range of 20 to 26 volts. Nevertheless, in the former the best performance is at the rated 115 volts and in the latter 24 volts. For continuous op-



LINE DROP is a major factor in low voltage wiring design. Chart gives wire sizes for a 6 volt system.



WIRE SIZES required for a 24 volt system. Note that starting current determines the wire size.

and Wiring

Standard voltages and good wiring system design are critically important in signal system installation.

eration the signal units must be specially wound. In the large systems consisting of low-voltage multiple signal devices windings must be furnished to suit the conditions.

Transformers should be selected upon the basis of the total volt-ampere requirements of all signals which operate simultaneously. The correct transformer to use is the one having the next highest volt-ampere rating above the total requirement to operate all signals.

The standard sizes of signal transformers are 50, 100, 250, 500, 750 and 1000 volt-amperes. Thus, if the total load were 150 volt-amperes it would be necessary to use a transformer having a rating of 250 volt-amperes. The next size lower which is 100 volt-amperes would be entirely too small in output.

The output of a signal transformer is based upon the maximum secondary voltage of 24. Therefore, the use of intermediate taps which may be connected at every four volts over the entire range from 4 to 24 volts would only result in proportionate output. As an example: a 500 volt-ampere transformer would deliver the maximum or 100 percent output at 24 volts, however, at 12 volts the output would only be 50 percent or 250 volt-amperes while at 16 volts the output would only be $66\frac{2}{3}$ percent or 333 volt-amperes. Installation and equipment standards for 24 volt systems are the same as for 12 or 16 volts and consequently there is no advantage in using the lower voltages. In fact 24 volts is much preferred from the standpoint of efficiency and economy.

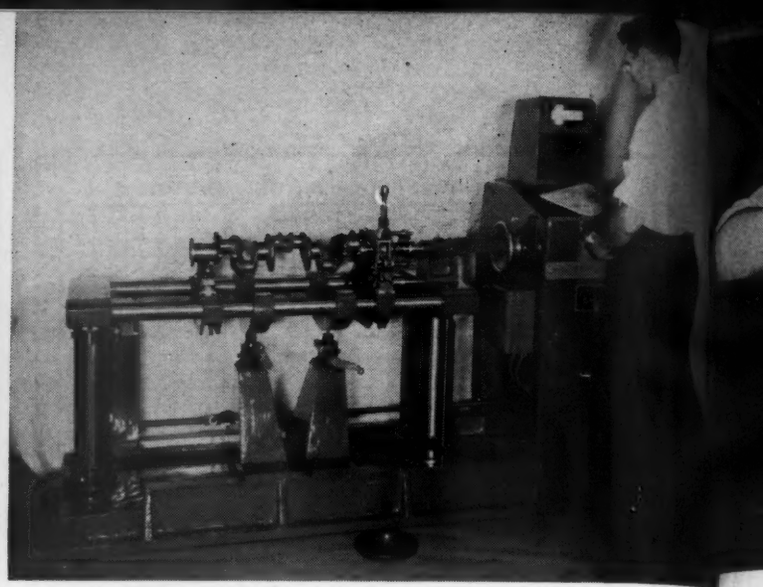
The output of a rectifier is selected upon the basis of the total starting current or ampere requirements of all signals which operate simultaneously. They can be had in practically any output to meet the requirements such as 1, 2, 3, 4, 5 amperes etc. For the best results they should be partially filtered especially where the use of relays are involved. Full wave rectifiers are preferred. As in the case of transformers, the next size larger to the specific load requirements is the rectifier to be selected. Rectifiers are used in existing systems where direct current is being replaced by alternating current and it is desired to use the original equipment. They are also used in cases where the equipment is to operate from the rectifier fed from an alternating current source, while a standby storage battery is used in the event of a power interruption.

The output of a storage battery is selected upon the basis of the total starting current or ampere requirements of all signals which operate simultaneously divided by the elapsed time of operation. The matter of voltage must also be considered so as to determine the number of cells required. With reference to the current output the following is a typical example: Assuming that a school has several systems such as clocks, bells, telephones and fire alarm. The secondary clocks 60 seconds, a total of 1440 contacts draw 2 amperes once in one minute or each day at 2 amperes or a total of 2880 ampere seconds. The program bells draw 3 amperes and operate 10 times each day for a period of 5 seconds or a total of 150 ampere seconds. The telephones draw $\frac{1}{4}$ ampere, operate 15 times each day for a period of 60 seconds or a total of 225 ampere seconds. The fire alarm system draws .015 ampere continuously or 1296 ampere seconds. The grand total will be 4551 ampere seconds.

The total of all current consumed by the various systems will be 4551 ampere seconds or approximately 1.25 ampere hours. Since a storage battery rarely returns all of the energy put into it the general practice is to figure on at least twice the amount of current as the circuits draw, plus a safety margin of about one ampere, which in this case would call for cells having an output of at least $3\frac{1}{2}$ ampere hours. The voltage of the system assumed to

[Continued on page 162]

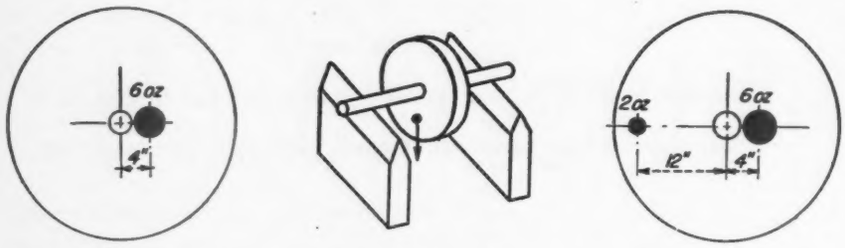
THE ELECTRIC MAINTENANCE COMPANY of Boston, Massachusetts, uses dynamic equipment made by the Bear Manufacturing Company, Rock Island, Illinois, to balance flywheels, armatures, gears and pulleys.



TO BALANCE CRANKSHAFTS and similar rotating parts, Chrysler of Canada employs static-dynamic equipment made by the Tinius Olsen Testing Machine Company of Philadelphia. Results are noted in operational efficiency.

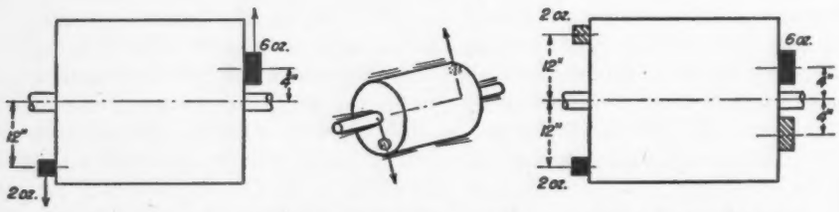
DYNAMIC

Vibration and wear of rotating parts, caused by an unbalanced distribution of weight, can now be located, measured and corrected rapidly, accurately and inexpensively.



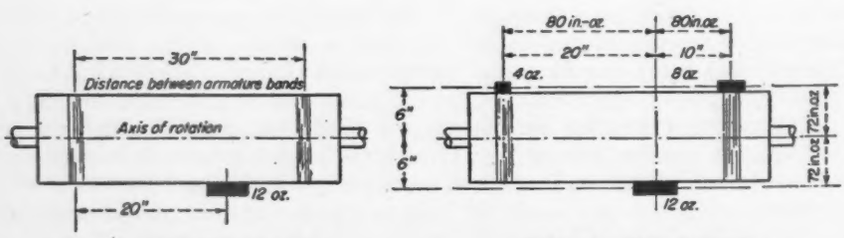
(a) Static unbalance — Effect of static unbalance: Self-induced rotation — (b) Static balance

FIG. 1. Disc on shaft supported by knife edges rotates until heaviest section of disc lies directly below shaft. This self-induced rotation is corrected by adding a compensating weight to the opposite side of the disc.



(a) Static balance Dynamic unbalance — Effect of dynamic unbalance: Vibration — (b) Static and dynamic balance

FIG. 2. When a body other than a disc (such as an armature) is unbalanced due to improper weight distribution at either end, vibration will increase with rotational speed. Compensating weights in the same perpendicular planes as the unbalancing weights will correct this fault.

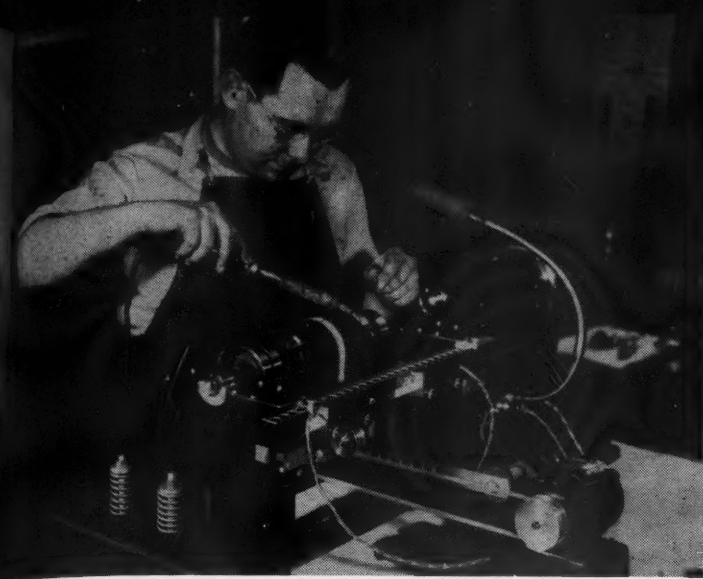


(a) Static and dynamic unbalance — (b) Static and dynamic balance

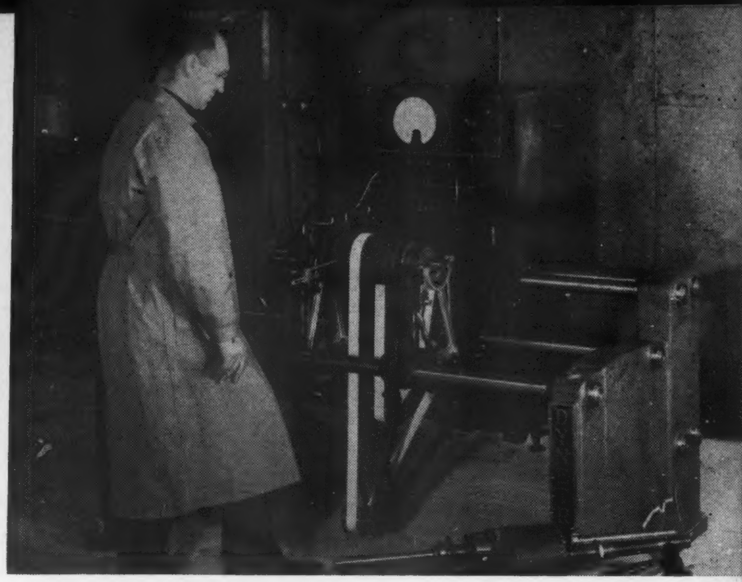
FIG. 3. When improper weight distribution occurs at a point other than at either end, static and dynamic balance can be reestablished by placing compensating weights at the ends, provided that the resultant force moments neutralize one another and result in a zero moment.

UNCONTROLLED power, attributed to unbalanced rotating parts, is a destructive force which can create excessive vibration, premature wear, costly maintenance, idleness of equipment and the eventual destruction of bearings. At best, vibration of fans, propellors and motors is an irritating nuisance. But even when vibration remains unnoticed due to its absorption by secure frames and sturdy mountings, internal damage and breakdowns can result from undetected wear of bushings, spindles, gears and shafts.

The amount by which a rotating part is out of balance means little when weight alone is considered, for rotational speed and the distance from the axis of rotation are more important factors. The fact that a slight condition of unbalance can develop into a destructive force is indicated by the fact that an inch-ounce of unbalance at 200 rpm. becomes 35 times as great at 1200 rpm. and exceeds 45 pounds at 5000 rpm. Although this has long been



DYNOGRAPH BALANCERS, made by the R. B. Annis Company of Indianapolis, incorporate the use of a cathode ray tube for indicating the location and amount of unbalance. Weight correction is accomplished by adding solder to armature bands.



A STROBOSCOPIC LIGHT source and belt drives are employed on the medium and smaller sized Dynetric balancing machines manufactured by the Gisholt Machine Company, Madison, Wisconsin.

BALANCE

By
Hugh P. Scott

known, correction in the past has been limited principally to static balancing due to the complications formerly encountered when seeking true dynamic balance, and the skill required for this type of work.

Static balancing is often acceptable when rotational speeds are low, for centrifugal and dynamic forces have minimum values under such conditions. In principle, static balancing consists of merely weighing a body which is free to turn on its axis, adding material to light sections or removing material from heavy sections until self-induced rotation is eliminated. This can be illustrated by Fig. 1, showing a disc revolving on a shaft supported by two knife edges. When 6 ounces of excess weight is located 4 inches from the axis (Fig. 1-a), a condition of static unbalance is created and the disc will develop self-induced rotation until the heavy section comes to rest directly beneath the axis. This unbalanced condition can be corrected by placing a counterweight on the opposite side of the axis, so positioned that the new rotational force (weight times distance from the axis) is equal to the force which caused the original unbalanced state. Therefore, to balance the 6-oz. weight located 4 inches from the axis (24 inch-ounces), a weight of 2 ounces can be placed at a distance of 12 inches from the axis (24 inch-ounces) on the opposite side (Fig. 1-b). Static balance will result, since these two forces are equal and opposite.

Since a disc was used for this illustration, both of the opposing forces lie in the same plane, perpendicular to the axis of rotation, and, as rotational speed increases, the resulting centrifugal forces will remain equal and directly opposed to one another so that the shaft is unaffected by a force couple. When a body thicker than a disc is tested, however, such as a cylinder or armature, the distribution of weight along the axis becomes important. Not only must counterweights be positioned 180 degrees around the axis from the unbalancing weights, but they must lie in the same perpendicular plane. Otherwise, two forces will be developed on rotation (Fig. 2-a); equal in magnitude, opposite in direction but not directly opposed in the same plane. So, although the cylinder is in static balance, a force couple will develop which will produce twisting and rocking action on the shaft, aggravating the original condition. This new development can only be corrected by placing two additional weights on the cylinder, equal in magnitude and opposite in direction to the forces of the twisting couple, and also in the same planes (Fig. 2-b). The cylinder will then be in true dynamic balance.

In this illustration, dynamic balance resulted with the original unbalancing of weights located at the cylinder ends. As frequently occurs, however, the unbalancing weight is not at either end but is at some intermediate position. (Fig. 3-a). In such cases, a

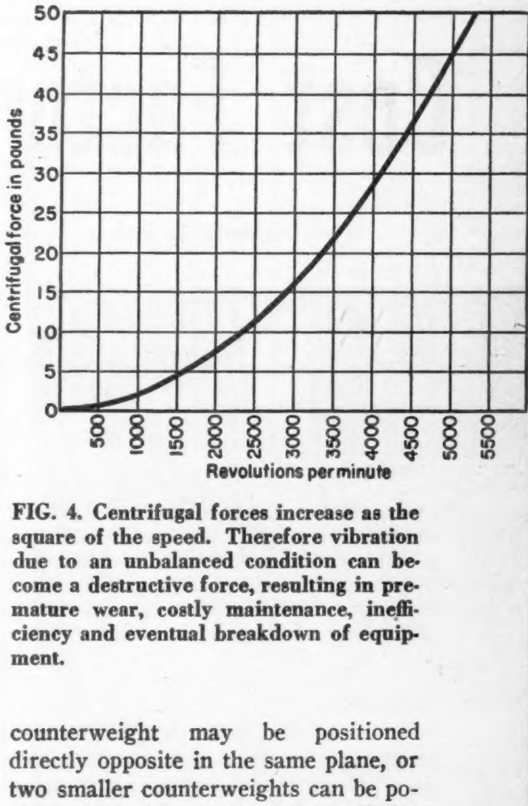


FIG. 4. Centrifugal forces increase as the square of the speed. Therefore vibration due to an unbalanced condition can become a destructive force, resulting in premature wear, costly maintenance, inefficiency and eventual breakdown of equipment.

counterweight may be positioned directly opposite in the same plane, or two smaller counterweights can be positioned at either end of the cylinder on the opposite side. This last method simplifies the operation, for it is then unnecessary to locate the exact position of unbalance. To prevent the development of twisting couples, however, counterweights must be so selected and positioned that the resultant moments of forces remain zero under all conditions.

So essential is true balance to efficient operation of machinery, that practically all Government-written war contracts specified that "all rotating bodies must be in static and dynamic

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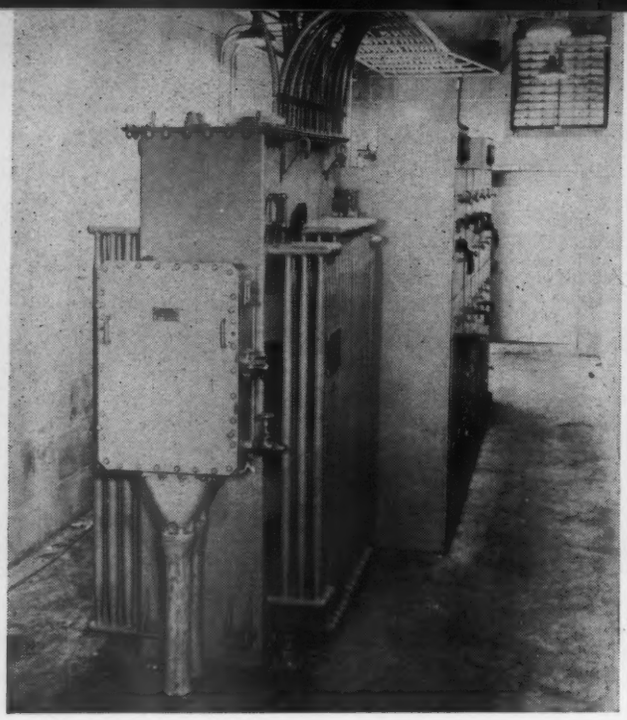
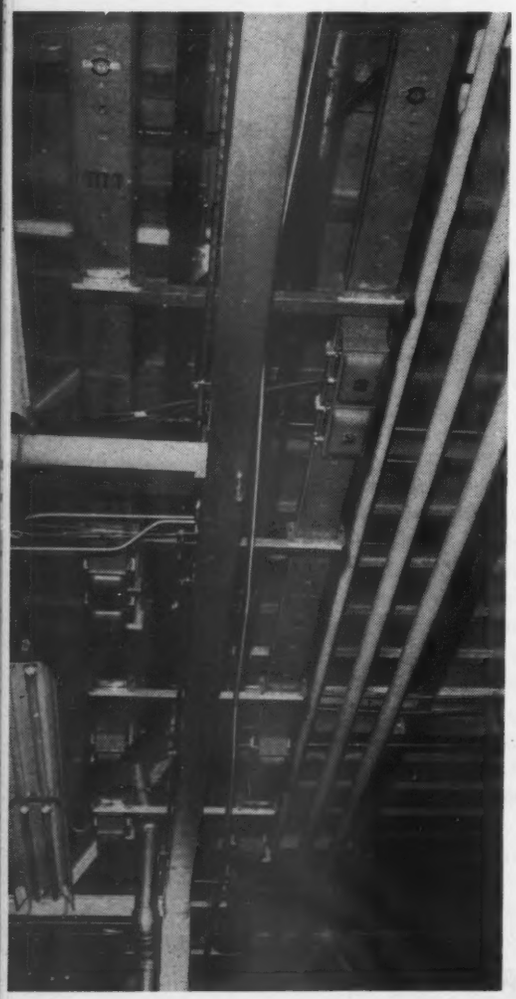


FIG. 15—Unit substation located adjacent to factory area. Shows interlocked armor power cable feeders.

FIG. 16—Typical panelboard using fuses for main and branch circuits.

Cost Factors For Cables . . . IV

Selection of cable sizes is discussed in this concluding article of the series.



By H. J. Finison

A TYPICAL electric power distribution system in a plant area where electric loads are distributed throughout the area will usually consist of a unit substation supplying low voltage feeder cables (Fig. 15). The cables extend to panel distribution boards (Fig. 16) or plug-in bus (Fig. 17) in the factory areas. These in turn supply power through small circuit breakers or fuses to the individual loads.

To illustrate the general problem of selecting cable sizes, a distribution system using panelboards will be considered.

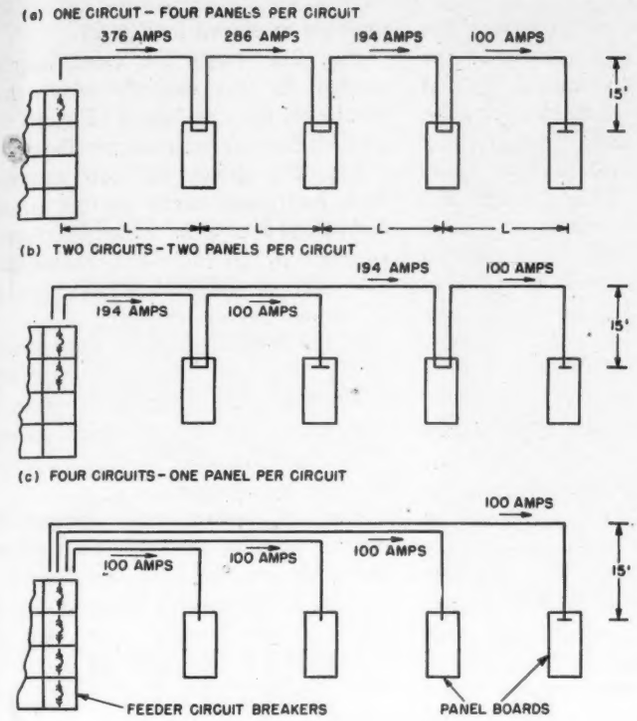
The panelboards may have main circuit breakers or fuses rated up to about 200 amperes. Hence, one, two, three, four, or even more of these panelboards might be supplied from a single large low voltage feeder cable or alternately from a number of smaller cables.

Case Study No. 1

Fig. 18 shows four 100-ampere panelboards which are assumed to be in the same direction from the unit substation. Arrangements are shown with all four panelboards supplied from one circuit, from two circuits, and with each panelboard supplied by its own individual feeder circuit. The estimated current with an assumed diversity and assumed load of 100 amperes on each panelboard are shown for each arrangement.

The National Electrical Code requires that the over-current protection for a cable circuit be capable of operating at not more than 150 percent of the cable rated current. It will usually

FIG. 17—Typical plug-in bus installation, hung from ceiling.



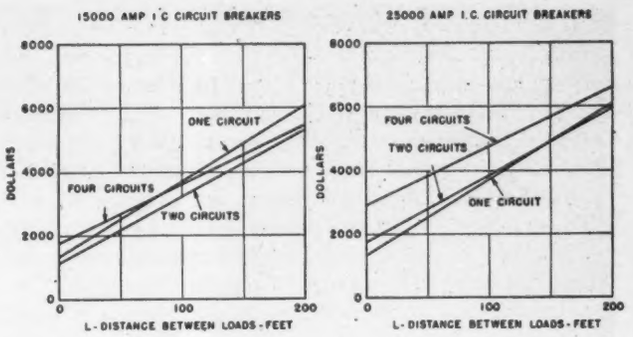


FIG. 18—Feeder arrangement for supplying four 100-ampere panelboards (left).

FIG. 19—Curves showing total cost of circuit breakers, installed cost of cables plus capitalized losses for feeder circuits supplying four 100-ampere panelboards as shown in Fig. 18 (above).

FIG. 20—Approximate unit price of feeder air circuit breakers (metal enclosed-drawout) (lower left).

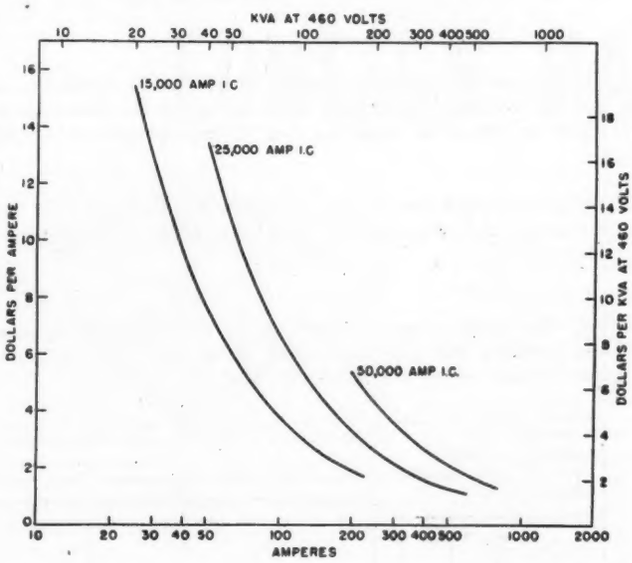
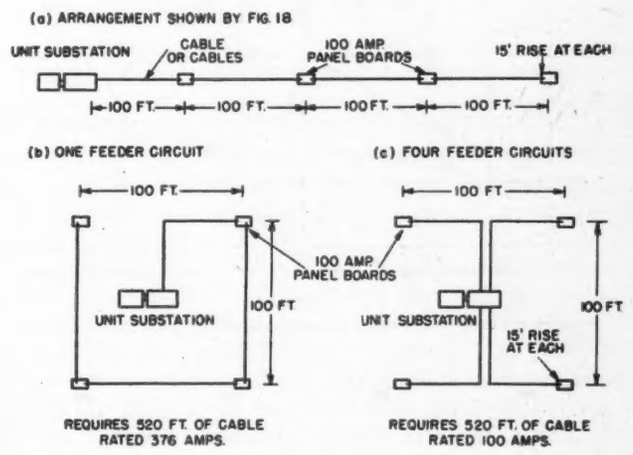


FIG. 21—Influence of feeder cable arrangement on required cable lengths (below).



not be desired to permit operation of the overcurrent protector except in event of current flow somewhat in excess of maximum load current, thus the overcurrent protector might be set at 125 percent above maximum load current.

For Fig. 18a the feeder circuit breaker might be selected to trip at around 475 amperes. And the minimum size cable which may be protected in accordance with the National Electrical Code requirement of 150 percent would have a rating of about 315 amperes. That part of the feeder circuit supplying the last panelboard will normally carry only 100 amperes. Yet, it must have a rating of 315 amperes in order to be adequately protected. Since this is almost as high as the 376-ampere rating required for the initial length of cable, it would be good practice to adopt the same size cable throughout with a rating of at least 376 amperes.

In Fig. 18a all four panelboards are supplied from a single cable feeder. Only the run of cable to the first load will be utilized to its full rating. Therefore, an arrangement where more than one load is supplied tends to cause excess cable cost since only a part of the cable is used to its full capability. Yet, the method may be economical since it requires only a single feeder circuit breaker.

Conversely, feeding each panel by a separate feeder circuit such as shown in Fig. 18c uses the feeder cable more effectively but requires additional expenditure for feeder circuit breakers.

Fig. 19 shows a comparison of the total cost plus capitalized losses including both cable and circuit breakers for three arrangements given in Fig. 18. The comparison is made for feeder circuit breakers having an interrupting rating of 15,000 and for 25,000 amperes. These curves are derived from the cable cost and circuit breaker cost data.

It will be observed from Fig. 19 that (with 15,000 ampere circuit breakers) the arrangement shown in Fig. 18 where two 100-ampere panelboards are supplied from each feeder is the lowest cost for all distances between loads of below 200 feet. The single feeder circuit supplying all four panelboards (Fig. 18c) is the second lowest for short distances, but at about 75 feet it becomes the most expensive of all arrangements. At a distance of 200 feet between loads, individual feeder circuits as shown in Fig. 18c approach the lowest cost arrangement, Fig. 18b.

With circuit breakers rated 25,000-ampere interrupting capacity, the single feeder circuit arrangement, Fig. 18a, is the lowest in cost up to about 130 feet between loads and thereafter, Fig. 18b, with two panelboards per circuit becomes less costly.

There is additional advantage in subdividing the circuits into as many feeders as can be economically justified. With a single feeder a case of trouble or short circuit on any portion of the feeder will result in interruption of power to all loads supplied by that feeder. With individual circuits only, the particular panelboard supplied by the faulted feeder will have an interruption of power. Hence, (with 25,000-ampere circuit breakers) the small additional cost of Fig. 18b compared with Fig. 18a may well be justified for even short distances between the loads.

Case Study No. 2

In the method of comparison shown by Figs. 18 and 19, it was assumed that the panelboards were located in the same direction from the power source and hence the cables all followed the same path. Actually, this will not usually be the case and additional savings may accrue by sub-division, since individual cables may be routed direct to their respective panel boards with a consequent saving in cable length. This will be illustrated by taking an example as shown in Fig. 21.

Fig. 21a shows the cable lengths needed for the example which has previously been discussed (Fig. 18 for a 100-ft distance between panelboards.)

Fig. 21b shows the new example with four panelboards on one circuit and Fig. 21c with each panelboard supplied by an individual feeder circuit, each of which is fed through its individual circuit breaker.

In the original example summarized in Fig. 21a subdivision of the circuits resulted in a considerable increase in cable length although of reduced rating.

In Figs. 21b and 21c equal lengths of cable are required.

Fig. 22 shows cost comparison curves including both circuit breakers and cable for Figs. 21b and 21c.

With 15,000-ampere interrupting capacity circuit breakers, and for all distances between loads of over 25 feet, the individual circuits are less costly. With 25,000-ampere circuit

[Continued on page 158]

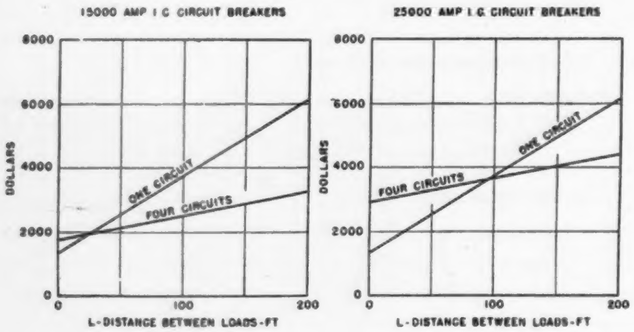
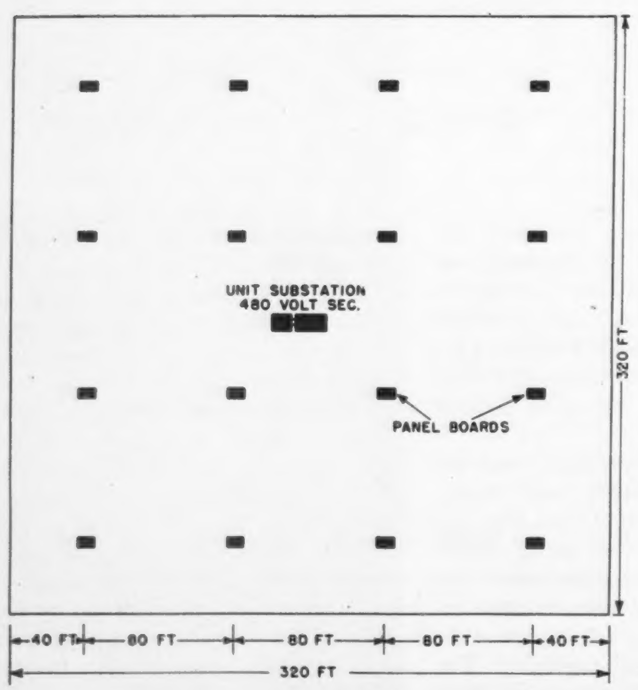
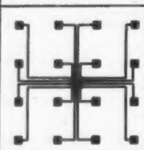
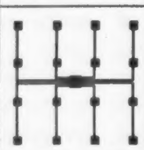
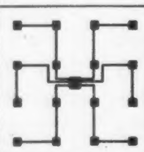
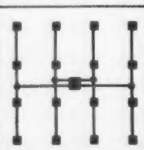


FIG. 22—Curves showing total cost of circuit breakers and installed cost plus capitalized losses for cables for arrangements shown by Fig. 21 for supplying four 100-amp. panelboards (left).

FIG. 23—Typical factory area with power supplied from a unit substation to 16 panelboards. Area approximately 100,000 sq. ft. (lower left).

FIG. 24—Comparison of total cost of feeder circuit breakers and installed cost plus capitalized losses for cable for typical factory load center area shown by Fig. 23 (below).



PANEL BOARDS PER CIRCUIT	CIRCUIT ARRANGEMENT	100 AMP. PANEL BOARDS		60 AMP. PANEL BOARDS	
		15,000 AMP. IC. CIRCUIT BREAKERS	25,000 AMP. IC. CIRCUIT BREAKERS	15,000 AMP. IC. CIRCUIT BREAKERS	25,000 AMP. IC. CIRCUIT BREAKERS
1		$ 11,800	$ 16,300	$ 10,600	$ 15,200
2		$ 9,100	$ 11,300	$ 7,200	$ 9,500
3		$ 10,500	$ 14,600	$ 7,300	$ 9,100
4		$ 18,300	$ 18,300	$ 12,000	$ 12,000

Intricate foreign equipment is rebuilt in this country to incorporate modern engineering practice.

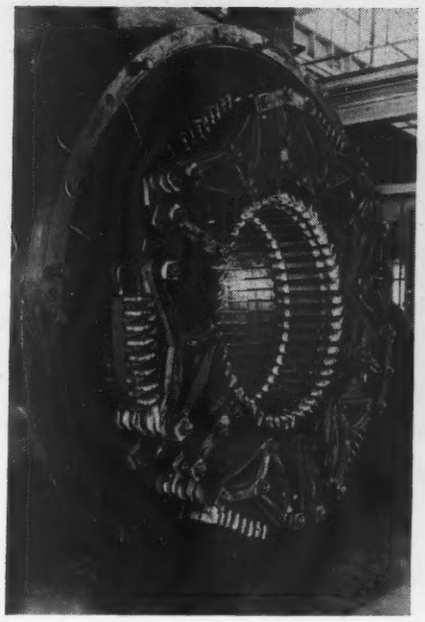


FIG. 1—A 3,000 kw. foreign-built turbo-generator after being rewound in National's repair department. Note the intricate bracing for end windings.

FIG. 2—Partially completed stator winding in an American turbo-generator unit of similar rating illustrates simplicity of American design.

Servicing FOREIGN-MADE MOTORS

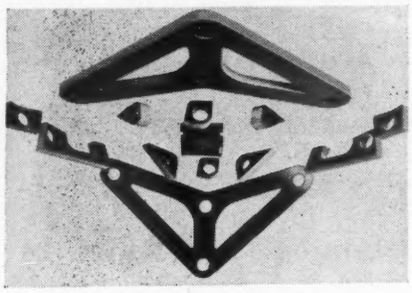


FIG. 3—A few of the odd and intricate insulating blocks required to brace the end windings of the foreign generator.

By J. E. Paoliello,
Engineer
National Electrical Coil Company
Columbus, Ohio

WHEN World War II developed into a long major struggle, an ever-increasing number of South American owners of electrical equipment manufactured in the war-devastated countries of Europe were faced with a serious maintenance problem. Normal sources of replacement parts were cut off because the plants were either converted to war production or completely destroyed. Lack of parts created a threat to production of such vital materials as tin, copper and nitrates, as well as electrical energy for transportation systems entirely dependent on the continued operation of existing equipment.

Owners of such equipment, much of which was built in Germany, turned to the United States for a solution to their problems. Many American companies were geared to production of vital war materials and could not accept such orders. A few, however, continued full-time production of their peacetime products, electrical coils and insulating materials. Despite production facilities that were strained to the limit by increased domestic demands, many orders from other countries were accepted and filled.

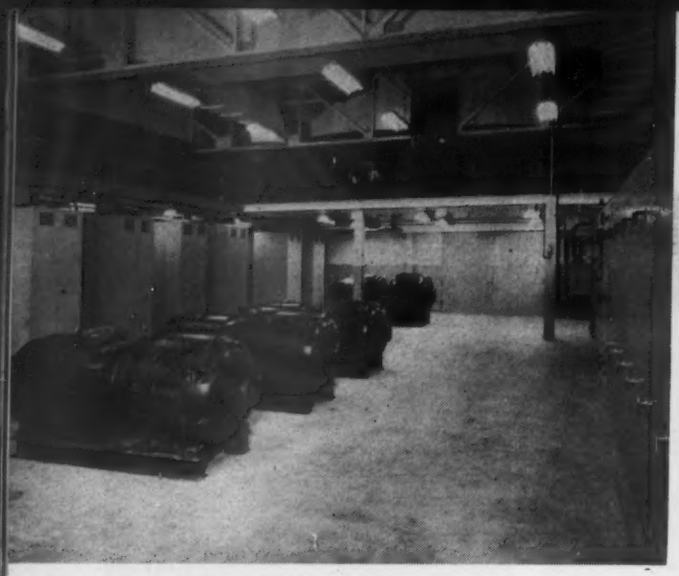
Among such orders was a 3,000 kw. turbo-generator shipped to Columbus, Ohio from Pernambuco, Brazil, South America. This unit supplied power for the transportation system in that city, and its failure seriously crippled the entire system.

Examination of the unit, upon its arrival at the plant, revealed that the insulation on the stator field winding had deteriorated beyond point of repair from long use and prolonged overloads. The maze of connections and methods of construction encountered were enough to "stump" the most skilled winders of American-made machines. However, after careful analysis of the existing winding, a new winding was engineered incorporating many outstanding improvements, and the rebuilding progressed with little difficulty.

While rewinding this machine, it became apparent that manufacturing procedures in other countries differed widely from those in the United States. It was evident that material was a critical item, while labor was abundant. Many parts utilized material to its fullest extent at the premium of many extra labor hours.

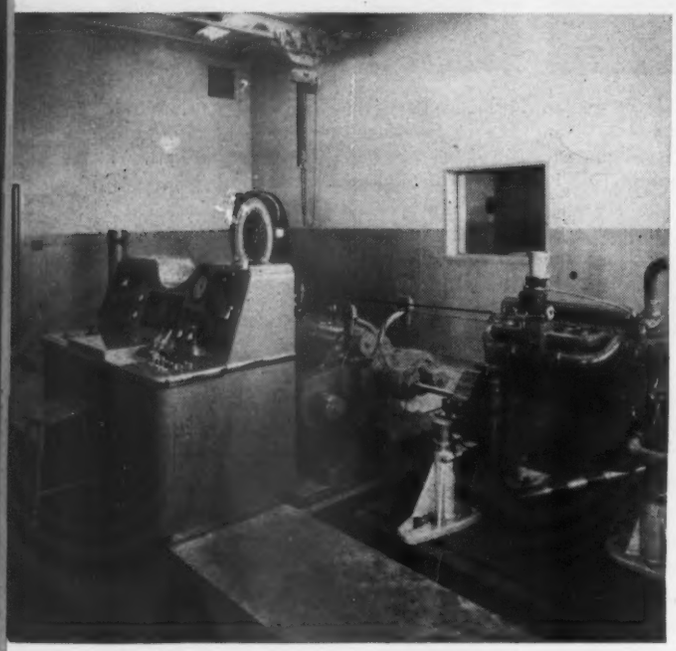
The stator winding consisted of two layers of straight bars in a closed slot. Each bar contained two separately insulated conductors with connecting clips on each end. After each layer was installed, end windings were soldered in place and connected to form a two-turn coil. The accompanying photographs show the many intricate insulating blocks and clamps required to hold the end windings in place; also emphasize the simple construction of American machines of similar ratings.

Wartime servicing provided experience in the design and manufacture of replacement coils and such equipment can now be supplied with coils to keep vital machines operating.



CENTRAL EQUIPMENT ROOM showing m-g, control, substation and ventilation equipment.

CORRIDOR BETWEEN equipment and dynamometer rooms contains fuel control station with gauges, switches and pilots.



INTERIOR OF DYNAMOMETER test cell showing control desk, dynamometer and test engine.

Wiring for Automotive Testing

Electrical system at GMC Truck and Coach Division's new dynamometer building incorporates sequence relay switching of lights and electrically controlled fuel distribution. Installation by John Miller Electric Company of Detroit.

By L. H. Gussow

Electrical Engineer
Detroit, Michigan

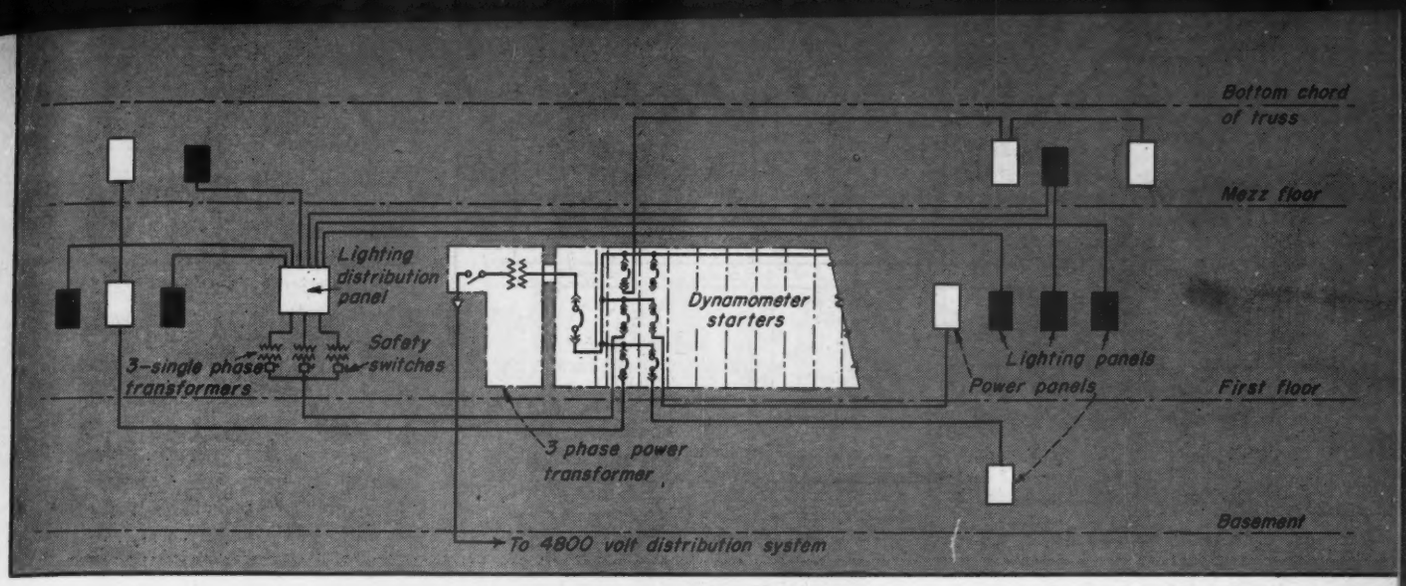
ONE of the largest buildings in existence devoted exclusively to experimental testing and development of automotive engines is the Dynamometer Test Building recently completed for the GMC Truck and Coach Division of General Motors Corporation at Pontiac, Michigan. The brick and steel structure was designed by Albert Kahn Associated Architects and Engineers, Inc. in cooperation with the GMC Truck and Coach Division engineering staff; is approximately 210 ft by 120 ft, with a full first floor, mezzanine and a part basement; incorporates a modern electrical distribution system tailored to fit specific requirements and installed by the John Miller Electric Company, Detroit contractors.

In a centrally located equipment room are the unit-type substation, the motor-generators, amplidynes and starting and control equipment for dynamometers. Practically all the dynamometer and other test rooms and offices are exterior rooms separated from the central equipment room by a wide corridor. Equipment for air conditioning one room and mechanically ventilating all others is installed on a mezzanine balcony overlooking the central equipment room.

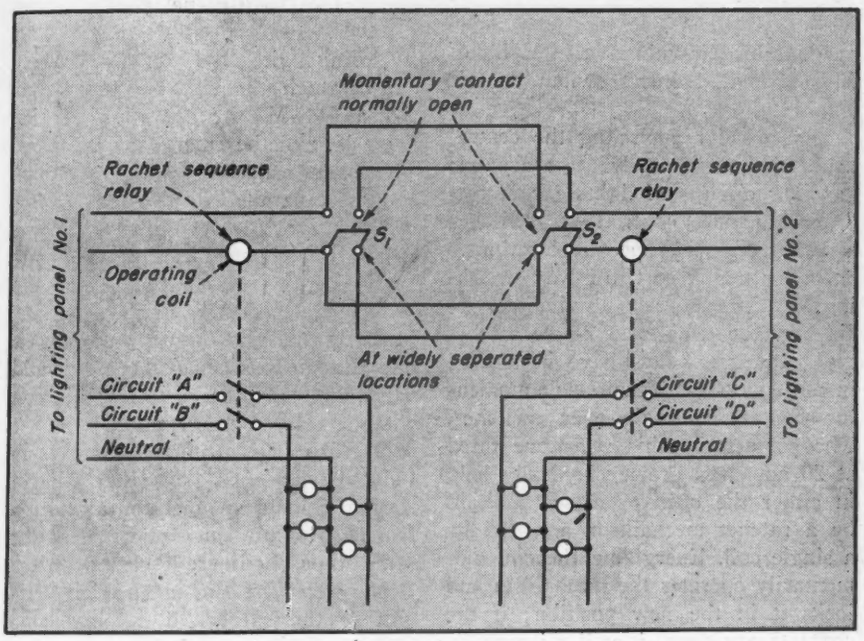
Foundations for the dynamometers and engines are completely isolated from the building foundations and from each other by structural cork. All test rooms are acoustically treated.

There are fifteen dynamometer rooms, each with one or more dynamometers ranging from 15 hp. to 400 hp. Development dynamometers are direct current type with motor-generator supply; durability dynamometers are water cooled inductor type. Facilities have been provided for testing complete engines, single cylinders, chassis, transmissions, brakes, axles and accessories. A cold room permits low temperature tests.

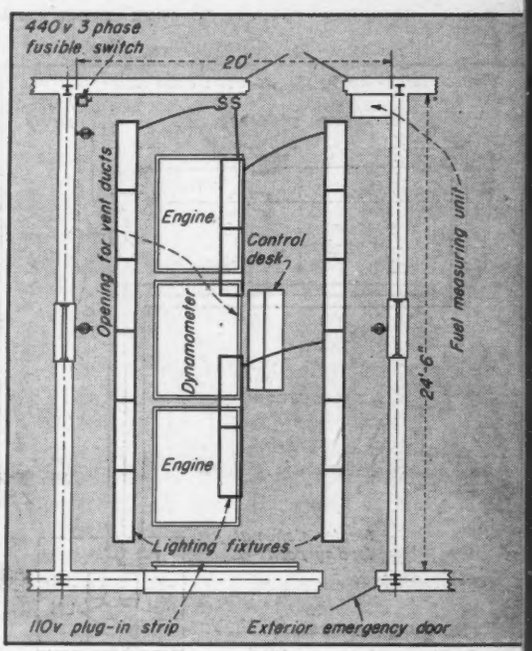
The unit-type substation comprises a 1500 kva., three-phase, 60 cycle, 4800/480-volt, transformer, with the primary disconnect switch interlocked with the main secondary circuit breaker; a branch circuit breaker sec-



RISER DIAGRAM of the lighting and power distribution system.



CORRIDOR LIGHTING control diagram showing use of two push button switches with ratchet sequence relays to control all units.



LAYOUT OF TEST ROOM showing dynamometer location and lighting.

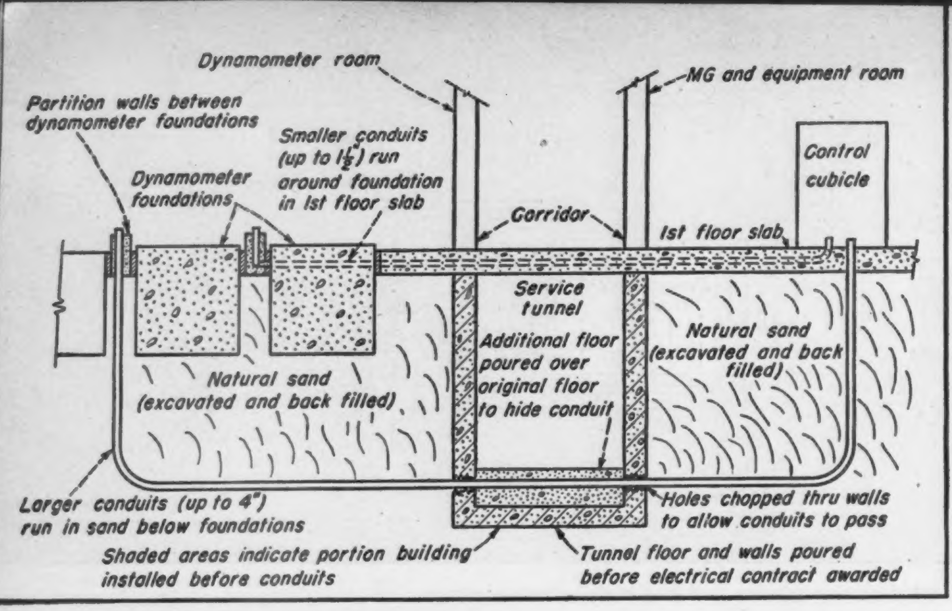
tion; and a section containing the starters for the motor-generators which supply the direct-current dynamometers.

Lighting service is single-phase, 3-wire, 110/220-volts, obtained from the three-phase, 480-volt secondary power service through dry-type transformers. The complete radial distribution system is shown in the riser diagram. Power panels and the lighting distribution panel have fusible branches; lighting panels, circuit breaker branches. All panels have main lugs only.

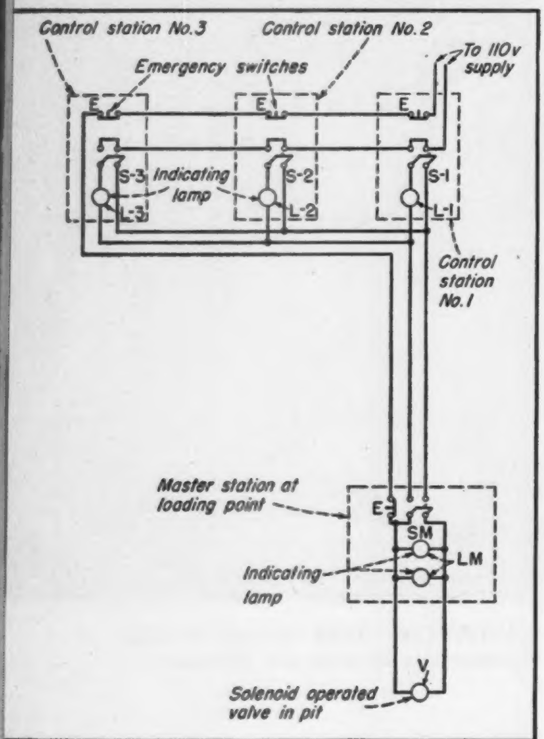
A control cabinet is located at each dynamometer location, either in the test room or outside, depending on the nature of the test. This enables the operators to control all test operations. Meters and gauges indicate speed, torque, fuel consumption, oil temperature, and other data. Conduits terminating at these cabinets originate in the central equipment room. Others run directly from this room to the dynamometers and engines. Under each control cabinet, an opening through the floor slab provides access to the basement and permits future installation of wiring or piping.

Keeping the multitude of conduits (up to 4-inch) in orderly arrangement, to facilitate maintenance and servicing, presented an interesting problem. Conduits terminating at the dynamometers or engines were turned up in the partition wall separating the machine foundations. No conduits pierce the cork-insulated machine foundations; many are run below the machine foundation and above the floor slab of the part basement.

To coordinate other building construction, the tunnel floor and walls were poured before the contract for electrical work was awarded. The first floor slab could not take the required number of conduits and the tunnel ceiling was filled with mechanical piping. The larger electrical conduits were run down from the control cubicles, across the floor of the tunnel and up into the partition walls between the multiple foundation of each dynamometer. Since the soil was mostly natural sand, it was possible to excavate and back-fill and then pour the foundations on top of the backfilled and tamped sand without fear of later settling. Finally a 6-in. concrete slab



SECTION THROUGH BUILDING showing typical conduit installation from central equipment room to "floating" dynamometer foundations.



SOLENOID VALVE fuel distribution control system. This diagram for a single valve is duplicated for each of six valves at the storage tank pit.

was poured over the conduits on the tunnel floor to make it passable and presentable.

Fluorescent lighting is provided throughout, with a few exceptions. Fixtures are industrial type RLM, each with two 40-watt, 3500 degree white lamps, surface mounted on the suspended ceiling. A few areas without ceilings use messenger cable suspension. Wherever feasible, fixtures have been installed in continuous rows.

The fixture pattern illustrated in the typical test room layout provides a maintained illumination intensity of 30 footcandles. Local switch control is used.

The corridor encircling the central equipment room is 265 feet around; has four circuits of lights (from two different panels) controlled by switches at two diagonally opposite locations.

Rather than resort to 3-way switching with its many wires and objectionable voltage drop, two 2-pole ratchet type sequence relays have been used in conjunction with two 2-pole momentary-contact, normally-open switches. The contacts in this relay are rated at 20 amperes; are mechanically held in either the open or closed position by a ratchet mechanism, actuated by a single coil. Energizing the coil momentarily operates the mechanism and locks it in the new position; if the contacts are open, it will close them, and vice-versa.

The attendant schematic diagram of the circuit shows how it works. Operating either switch will actuate both relays and turn on all the lights, if they were previously off; or turn them off, if previously on.

Fuel is distributed by means of a hydraulic system from six tanks to the several dispensing points in the Dynamometer Test Building and in the adjacent Engineering Building. Water under pressure forces the fuel out of the selected tank to the dispensing device. Six solenoid-operated valves (one for each tank) located in a pit adjacent to the tanks outside the buildings control the flow of water (either "on" or "off") and hence the flow of fuel. These valves are closed when the operating coils are de-energized.

Switches at one control station in the Dynamometer Test Building, and at two stations in the Engineering Building, control the individual solenoid-operated valves. Also, control station pilot lights indicate whether the valves have been opened or closed from that particular station, and hence which fuels are available. A master switch for each valve is located at the master station near the fuel loading dock outside the Dynamometer Test Building.

A schematic wiring diagram is shown for one valve controlled from three building stations and the master station. In normal operation the master switch S-M is closed. To illustrate the system operation, assume that switches S-1, S-2 and S-3 are all open, and that the operator at control station one wishes to use fuel controlled by valve V.

Closing switch S-1 completes a circuit through the right-hand sides of S-1 and S-M, the operating coil of valve V, and the emergency switches. This opens valve V, and lights lamps L-M (in parallel with the operating coil of valve V). At the same time a circuit is completed through the left-hand side of S-1, lamp L-1 and the left-hand side of S-M. Lamp L-1 lights, indicating to the operator at station one that he has opened the solenoid valve, and can proceed to use this fuel without fear of interruption.

Operation of switch S-1 gives no light indication at any other control station. Should an operator at station two wish to use this same fuel at the same time, he merely closes switch S-2, completing an independent circuit to the valve and causing lamp L-2 to light. When either operator has finished using the fuel he opens his switch, causing his own light to go out, but not interfering in any way with any other user. Since each control station indicates only the condition of its own circuit, each operator habitually turns on his own switch to be sure of obtaining fuel without interruption and interference with the supply at another station.

When all control station switches are open, valve V coil is de-energized and the valve is closed; all indicating lights are out, including the light L-M at the loading station. The loading station attendant knows that he can then open the master switch S-M without interrupting the fuel supply to any user. Opening switch S-M breaks valve V operating coil circuit and prevents operation of the valve from any control station. The left side of switch S-M being open prevents station pilot lamps from lighting when

[Continued on page 156]

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

New finishing plant of Holeproof Hosiery Co., Marietta, Ga., uses 5000 feet of Surfaceduct installed in grid pattern under roof trusses to support fluorescent lighting fixtures as well as to provide power for lighting. Fixtures are easily moved to new locations to meet varying requirements.

Raceways Serve Double Purpose

WIRING

A network of surface raceways suspended from roof trusses are serving double duty in the new finishing plant of Holeproof Hosiery Company, Marietta, Ga. It not only provides a wireway for the branch feeders of the lighting distribution system, but also serves as a fixture hanger.

The steel raceway used is Surfaceduct. It consists of a channel with snap-on cover, has an ingenious bridge which securely locks the capping, and permits installation of duplex outlet receptacles wherever required. In the 40,000 sq. ft. Marietta plant, lengths of the raceway were installed in parallel runs down the length of the building. Other lengths were installed across the width of the building, forming a grid pattern. Junction boxes form rigid and unobstrusive connections at points where the runs of Surfaceduct cross each other.

In order to provide the double duty feature, special hangers were mounted on the 1-5/8 in. by 2-1/8 in. raceway to which the chain hooks from the fluorescent lighting fixtures are attached. Power is furnished to each lighting unit through a flexible cord with plug which is fed from the conveniently located duplex receptacles installed in the raceway. Since new receptacles can be easily installed wherever needed in the raceway, and since the special hangers for lighting fixtures can be mounted in new locations in a matter of minutes, this system makes it easy to change fixture locations and provide light where most needed. This flexibility in lighting is needed to meet radical changes in production schedules which often occur and requires a complete rearrangement of movable tables used for matching and inspection purposes.

The result is geometrically pleasing, flexible, efficient and adequate for reasonable future expansion as well as present distribution requirements.

Proper Maintenance Saves Windings

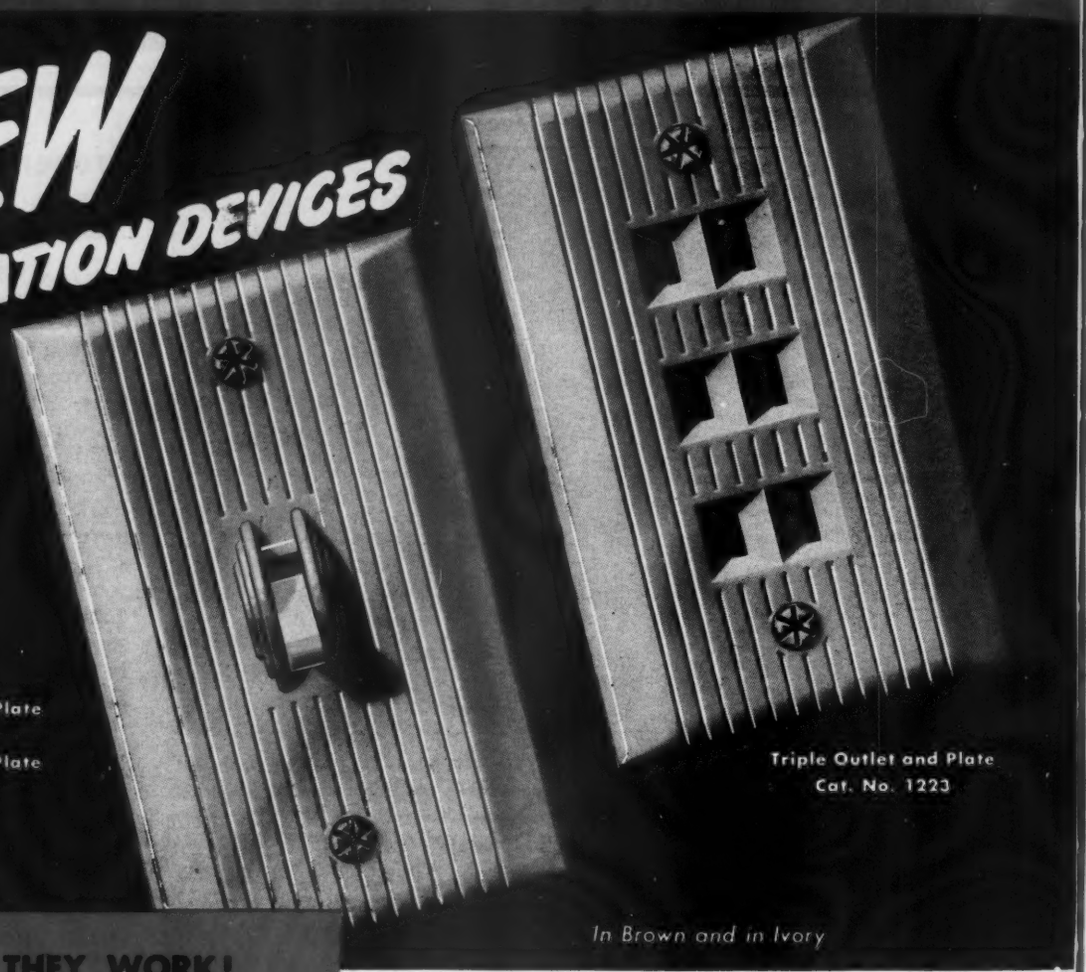
MAINTENANCE

The average motor is constructed to give many years of service, provided it is used for the purpose for which it was designed, maintenance is in accordance with recommended practices, and it is correctly connected into the wiring circuit. As emphasized by William J. Wheeler, president of the Maintenance Company, Inc., New York City, motors should be returned to service as speedily as possible after a shut-down but, in conjunction with correcting the *fault*, the *cause* for the failure should be traced and the reasons behind the failure should be analysed. By tracing trouble to its source, the repair crew may discover that the failure was due to overloading, low voltage, too little or too much oil, improper maintenance or, as in the case discussed here, improper circuit operation. If the *failure only* is corrected, leaving the *cause* in its original condition, it is a logical assumption that the failure will again materialize due to the continued cause.

The wiring diagram (1) shows a single phase motor driving a blower, the blower being located on the roof of a building while the starter is located on the floor below the roof level. During a maintenance check-up, it was noticed that the manufacturer's wiring diagram was pasted inside the starter housing to show the wiring of the motor and its control equipment. However, on tracing the circuit, two switches (a and b) were discovered rather than just one (a) as indicated on the wiring diagram. It was reasoned that the second switch (b) no doubt had been installed for safety reasons, in accordance with the city electrical code which states that "a motor and its driven machinery shall be within sight of the point where the motor is controlled, except where a suitable manually operable switch, which will prevent the starting of the motor, is placed within sight of the motor location. This switch may be placed in the remote control circuit of a remote control type of switch (or controller)."

AGAIN MONOWATT SPEEDS JOBS...

NEW COMBINATION DEVICES



Single Pole Switch and Plate
Cat. No. 1321
Three Way Switch and Plate
Cat. No. 1323

Triple Outlet and Plate
Cat. No. 1223

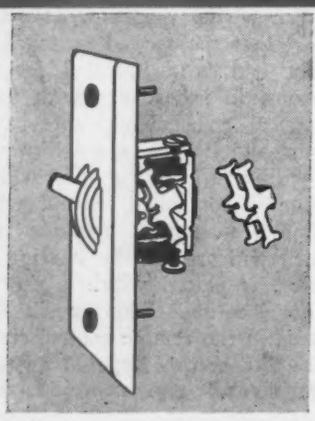
In Brown and in Ivory

LOOK HOW THEY WORK!

They combine in one installation unit both device and plate!

Compare the advantages of this with installing plates and devices separately.

LOOK AT THEIR FEATURES!



THE SWITCHES
"T" Rated to Last Longer

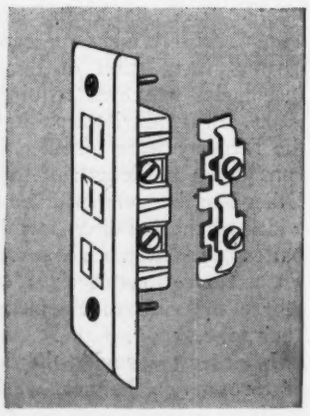
1. Double contacts handle the load better,
2. Special kick-off makes positive mechanical action certain.
3. Arc snuffers smother the arc at each of the double contacts.
4. Trigger guard molded on plate protects the trigger.

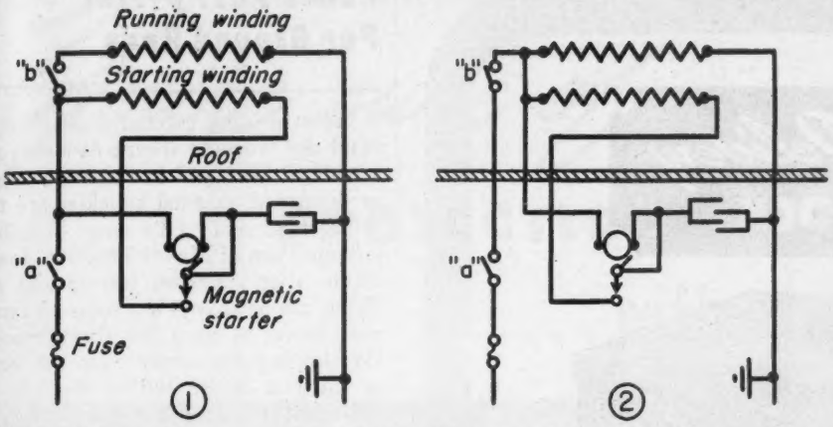
THE PLATES
New Features to make Your Job Easier

1. Plate mounts complete device flush.
2. Screws already in place for quick mounting.
3. Oval screw holes for quick squaring.
4. Plate breaks off for ganging.

THE OUTLET
Built for Extra Service

1. Three outlets—not just two.
2. Double contacts of heavy spring bronze grip both sides of plug blades securely.
3. Four large terminal screws—take No. 10 wire.

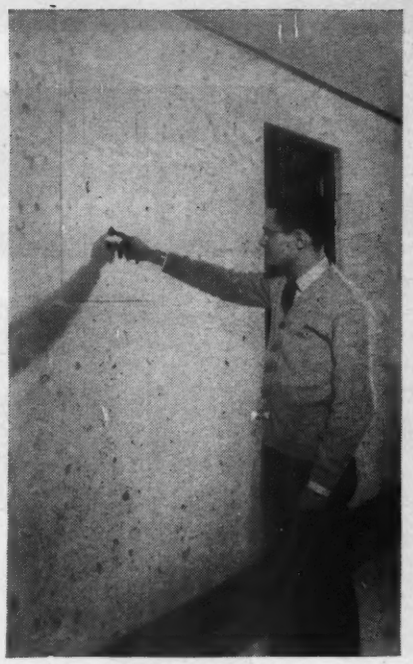




With single phase motor controlled and wired as shown in diagram No. 1, starting windings are subject to overheating and ultimate winding failure can be expected. Rewiring as shown in diagram No. 2 satisfies electrical code and protects motor windings.

By reference to the wiring diagram (1), it is apparent that it is possible to stop the motor at switch "b", complying with code requirements, but, with switch "a" remaining in a closed position, the starter would remain energized and the starter contacts, being in series with the starter windings, would remain open as long as the starter remained in this energized condition. When switch "b" is reclosed, the motor would not start, for such a single phase motor is not "self starting" unless phase displacement is obtained by means of a starting winding. As in most cases, the starting winding of this motor is cut out of the circuit after the motor is once running. Since the starter contactor remained energized while switch "b" was open, the starting winding was cut out of the circuit by its contacts and, on reclosing this switch, the running windings were subjected to severe overheating. Even though the operator would go down and reclose switch "a" immediately, the windings would still overheat to some degree and ultimate failure of the windings could be expected. With this arrangement, it was necessary to open and then reclose switch "a" to restart the motor.

The motor was rewired in accordance with wiring diagram (2) and it then became possible to stop or start the motor from either switch location, providing the other switch was already closed. The code was still satisfied and motor windings were protected from damage from overheating.



Emergency shut-off pushbutton projects through cover of corridor power panel in new geophysical laboratory designed by the Austin Company for the Shell Oil Company in Houston, Texas. Pushing large red button disconnects panel feeder and cuts off power to all laboratories served by panel; shuts off air conditioning; closes solenoid valves on other building services; sets off audible and visual alarm signal. Door must be opened to push reset button.

Pry-Out Plate On Box Cover

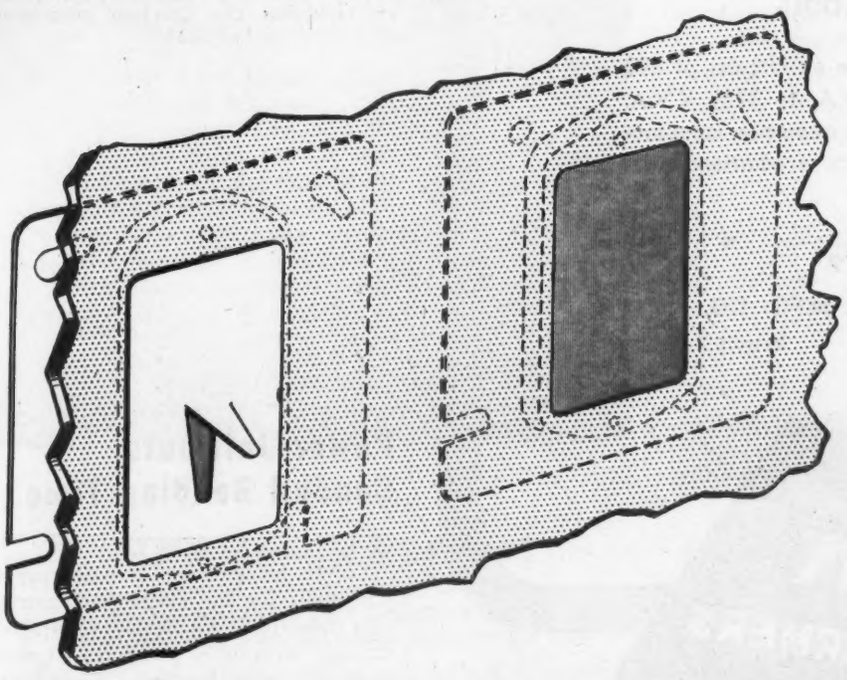
WIRING

P. J. Falson, Falson Electric Company, Chicago electrical contractor, does a substantial amount of residential wiring. Like other contractors in this field, he has experienced the difficulty of "hunting" wall outlets after the plasterers have gone through a house. So he decided to do something about the situation. Result: A newly designed pry-out plaster plate cover for the No. 1900 outlet boxes.

The plate seals the box during plastering and eliminates the need for cleaning out boxes when installing switches and receptacles. It also has a metal "finger" that projects through the plaster and permits electricians to quickly spot the outlet even though it is covered with plaster.

A screw driver is all that is needed to pry out the plate which leaves a clean break in the plaster and a clean box interior.

Falson has applied for a patent on his new cover and plans to have several outlet box manufacturers make the device under a license agreement.

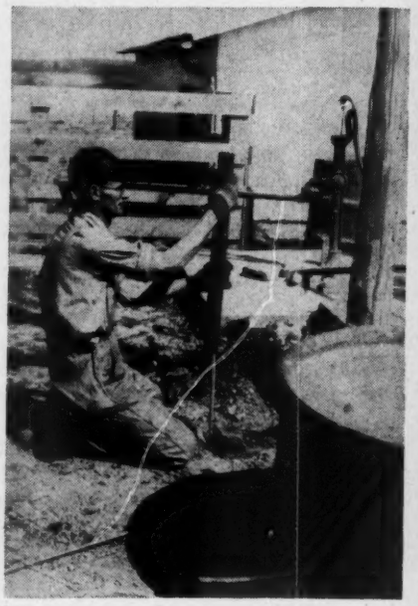


New outlet box cover has pry-out plaster plate with projecting finger (left). Removal of plate after plastering is completed leaves a clean box opening (right).

Fence Post Driver For Ground Rods

CONSTRUCTION

When driving ground rods, using a maul and working from a ladder, rods are often bent, rod heads are mashed or deformed, skinned knuckles are not infrequent and falls are possible. George Pero of Mount Pleasant, Iowa, claims that knuckles, temper and religion can be spared if a common fence post driver is used for this purpose. By slipping the driver over the head of the rod before setting the rod in position, an 8-foot rod can be driven



Fence post driver, slipped over the head of a ground rod, drives rod into ground quickly without damaging rod or involving the dangers associated with ladders and mauls.

easily without using either ladder or maul. Since the driver always strikes the head of the ground rod squarely, rods are not deformed or bent. Contractors driving a large number of rods, such as on an REA project or sizable industrial job, might find that this method is rapid and will protect both material and personnel. Purchase of a driver can be made in most farm supply or hardware stores.

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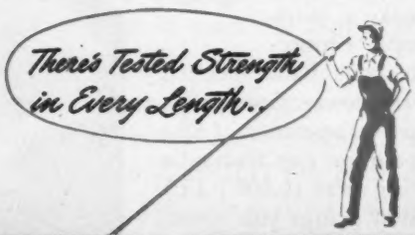

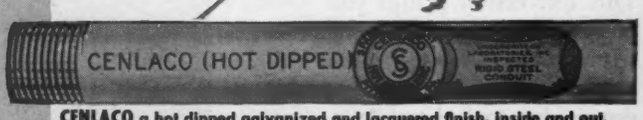

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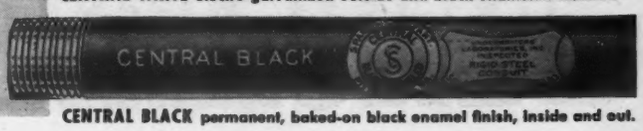

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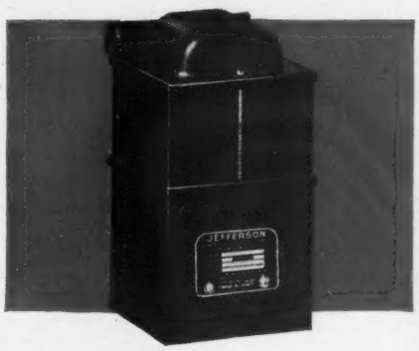

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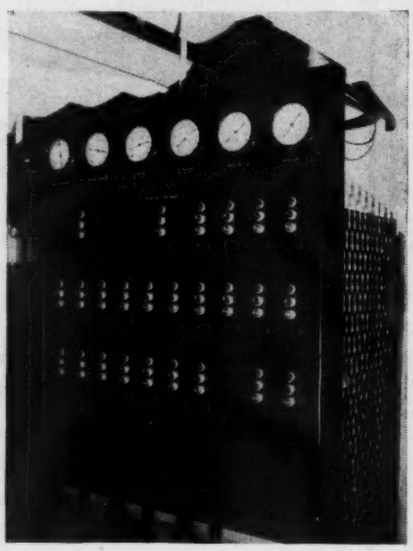
duit bending labor in one week to pay for the power unit. Data taken from time study records indicated that a two-man crew made 60 off-sets in 1½-in. pipe in a four-hour period. Labor cost: Eight man-hours at $4.00 per hour (overtime)—Total $32.00. This was for duplicate offsets and included bending time only (no cutting included). To duplicate the offsets, two marks were made on each piece of conduit; the ram stroke was pre-determined; the control valve opened and the motor did the rest. The contractor estimated that it would have taken this two-man crew 12 hours (24 man-hours) to make these offsets with a hand-operated bender. Total labor cost would then have been $96.00 (24 hours times $4.00 per hour). Thus his labor saving on one four-hour conduit bending assignment was $64.00 under overtime conditions.

Much of the bending on this project was done on a long bench with the bender and power unit on the bench top. The mechanic used one hand to operate the power unit control valve; used a ruler in the other to measure ram travel and degree of offset. In this way the two-man crew could work on a production-line-basis, one handling the conduit and the other operating the bender. The fatigue normally associated with bending assignments is practically non-existent with the power unit.

Application of the power unit to a hydraulic pipe pusher was also reported. The project involved pushing 60 feet of 3-inch pipe underground.



Compact pushbutton control panel provides finger-tip control of 25 air-conditioning compressors, fans and pumps at Shell Oil Company's new Houston, Texas geophysical laboratory designed and built by the Austin Company. Instruments at top provide visual indication of critical operating conditions.

Selection and Application of V-Belt Drives—II

Recommended procedure for selecting and engineering a V-belt drive.

By C. J. Busacca and F. H. Rumble
Texrope Department
Allis-Chalmers Manufacturing Co.
Milwaukee, Wisconsin

IN the first part of this discussion we considered the theory of operation of V-belt drives; why they require a different installation and maintenance technique; the types of belts and sheaves available; and the advantages of each. In this second and final article, we shall briefly sketch the steps necessary to properly engineer and install a V-belt drive.

To select the proper drive for a V to V multiple-belt application, a comparatively simple seven-step procedure is followed. It is known as the "formula method" for calculating drives and makes use of the following Tables:

Table I—Recommended Size (Pitch Diameter) for Driving Sheave

Table II—Arc of Contact Correction Factor for V to V and V to Flat Drives

Table III—Service Factors For Various Applications

Table IV—General V-Belt Selection Table

The following are the seven steps involved:

1. *Known Factors*—Horsepower, speed of motor, speed of driven unit, approximate center distance.

2. *Belt Selection*—Determine belt section to be used for a drive of certain horsepower and speed from Table IV.

3. *Actual Horsepower of Drive*—Selection of a drive for any application should be based on the nature of the load and the type of driving unit. *To obtain this actual horsepower capacity, multiply the rated (nameplate) horsepower of the motor by the service factor (Table III).*

4. *Ratio of Drive*—can be determined from the following formula:

$$\text{Ratio} = \frac{\text{Driven rpm}}{\text{Driver rpm}}$$

5. *Sheave Selection*—Determine belt length (L) by using the following formula:

$$L = 2C + 1.57\,(D + d) + \frac{(D-d)^2}{4C}$$

L — Pitch length of belt
D — Pitch diameter of large sheave
d — Pitch diameter of small sheave
C — Center distance

Center distance may be calculated by using the following formula:

$$C = \frac{L - (D + d)\,1.57 - \frac{D^2 - d^2}{1.57\,(L-R)}}{2}$$

R = Ratio
All other symbols same as above.

7. *Horsepower Per Belt*—

A. Determine belt speed in feet per minute. ***Belt speeds over 5,000 feet per minute are not recommended.*** Use the following formula:

Belt Speed = Pitch Dia. driver sheave x rpm of motor x

$$\frac{\pi}{12} \text{ or } .262$$

B. Correct for Arc of Contact:

$$\text{Arc of Contact} = 180° - \frac{(D - d)\,60}{C}$$

Symbols same as for formulae above.

Then: refer to Table II for Correction Factor.

Then: Actual hp. per belt = Nominal hp. × Correction Factor.

8. *Number of Belts For Drive*—Divide the actual rated horsepower of the drive by the actual horsepower per belt. If the result is a fraction, use the next higher number of belts.

Table I

RECOMMENDED SIZE DRIVING SHEAVE

Section	Minimum Pitch Diameter	Maximum Pitch Diameter
A	3.0"	Sheaves developing belt speeds in excess of 5000' per minute are not recommended.
B	5.4"	
C	9.0"	
D	13.0"	
E	21.6"	

Table II

ARC OF CONTACT—CORRECTION FACTOR

$$\text{Arc of Contact} = 180° - \frac{60\,(D-d)}{C}$$

ARC	180°	170°	160°	150°	140°	130°	120°	110°
Factor	1.00	.98	.95	.92	.89	.86	.83	.79
Factor	.74	.76	.79	.82	.84	.86	.83	.79

Note: Factors in upper line are for V to V drives.
Factors in bottom line are for V to Flat drives.

Table III

SERVICE FACTORS

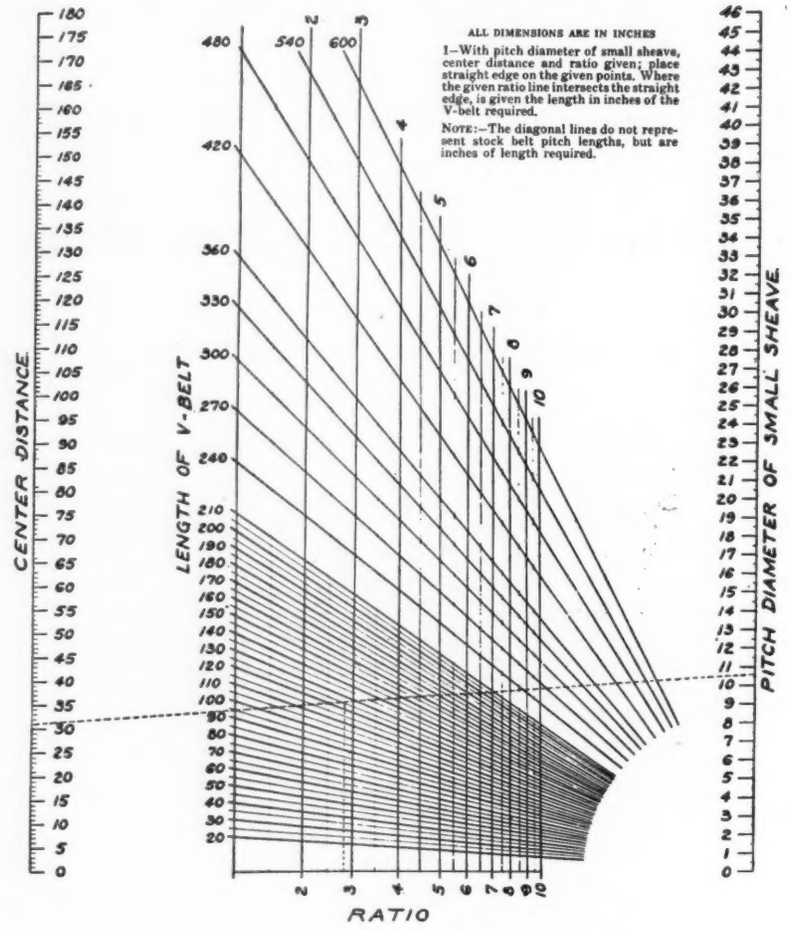
Following are some of the more general applications with corresponding Overload Factors. (Reversing service or Line Start Motors require an additional 1.2 overload factor.)

Agitators, paddle-propeller...	1.0–1.2
Brick and Clay Machinery....	1.2–1.6
Bakery Machinery.....	1.0–1.2
Compressors.....	1.2–1.4
Conveyors.....	1.0–1.6
Crushing Machinery.....	1.4–1.6
Fans and Blowers.....	1.2–2.0
Flour-Feed and Cereal Mill Machinery.....	1.0–1.4
Generators and Exciters.....	1.2
Laundry Machinery.....	1.2
Line Shafts.....	1.4–2.0
Machine Tools.....	1.0–1.4
Mills.....	1.4–1.6
Oil Field Machinery.....	1.2–1.6
Paper Machinery.....	1.2–1.6
Printing Machinery.....	1.2
Pumps.....	1.2–2.0
Rubber Plant Machinery.....	1.4–2.0
Screens.....	1.2–1.4
Textile Machinery.....	1.2–1.8

The Service Factor selected depends on peak and shock load in excess of 100% full load. Where shock and peak loads are light, use the lower Service Factor—for severe loads, use the higher Service Factor.

CHART A

Guide to Approximate Length of V-Belts



$$\text{Number of Belts} = \frac{\text{Actual rated horsepower of drive}}{\text{Actual horsepower per belt}}$$

Common errors in engineering V-belt drives are: Using too high a belt speed; an improper service factor; an improper arc of correction factor; or using pitch diameters below recommended sizes.

When using the formula for obtaining belt speed it is recommended that belt speeds never be in excess of 5,000 feet per minute. Beyond this value, no increase of belt horsepower is obtainable.

Not only horsepower and speed, but also the nature of the load and the type of driving unit should be carefully considered when engineering a drive. The Service Factor Table (Table III) takes into consideration and correlates the types of driving units and the types of loads, giving a service factor to cover overload and shock loads in excess of 100 percent of normal load. *By multiplying the rated hp. of the motor by the service factor, the actual required hp. for the specific application is obtained.*

Horsepower ratings for all drives are based on an 180 degree arc of contact for belt on sheave. When this arc of contact drops below 180 degrees, the tractive effort is reduced. This is shown by the correction factors to be used for varied arcs below 180 degrees (Table II). Hence, an arc of contact of 150 degrees will transmit only 92 percent of the load transmitted when the arc is 180 degrees.

All belt sections have a minimum bending arc. When belts bend too sharply, the inner cords are strained or even broken. To prevent this belt strain, each sheave section has a minimum arc recommended for its corresponding belt. Hence, the minimum arc for a "C" section belt is the arc of a 9.0-inch sheave as shown in (Table I).

When engineering a drive, it is most helpful to have a guide to the approximate length of the V-belt to be used. When the pitch diameter of the small sheave, the center distance, and the ratio are known, the approximate length of the V-belt can readily be found by referring to Chart A.

The V-flat drive is one using a grooved driver sheave, V-belts, and a large driven flat pulley. When a drive is being converted from flat belt to V-belts, it is sometimes economical to use the existing flywheel and thereby lower conversion costs.

If the large flywheel is to be used, the following points should be considered:

1. The speed ratio must be equal to or greater than 3 to 1.

2. The ideal center distance is three-fourths the diameter of the flywheel; the maximum center distance is 1½ times the flywheel diameter.

3. Where possible, uncrowned flat pulleys or flywheels should be used, though a slight crown may not prevent the drive from operating satisfactorily.

4. The face of the flywheel should be 10 percent wider than that of the corresponding grooved sheave.

5. The drive should be engineered with sufficient belts to cover the overload and arc of contact factors.

As may be noted (Table II) the arc of correction factor for V-flat drives is different in many cases than that for V to V drives. Care should be taken to use the arc correction factor for

V-flat drives when figuring that type of drive.

To determine the pitch diameter of the large flat pulley, use its outside diameter plus the thickness of the belt section used. In all other respects follow the identical procedure as for the V to V drive. When engineered properly, a V-flat drive gives satisfactory results.

Flywheel Effect

With pulsating loads, a pulley or sheave with a flywheel effect is needed. What flywheel effect a certain size and type of sheave or pulley will deliver is dependent upon the mass of the sheave rim.

To calculate flywheel effect use this formula:

Flywheel Effect $= WR^2$
W = Rim weight in pounds
R = Mean radius in feet

To determine the amount of metal to be added to a sheave rim for additional flywheel effect, the chart "B" has been developed. The method for using this chart is explained beneath it.

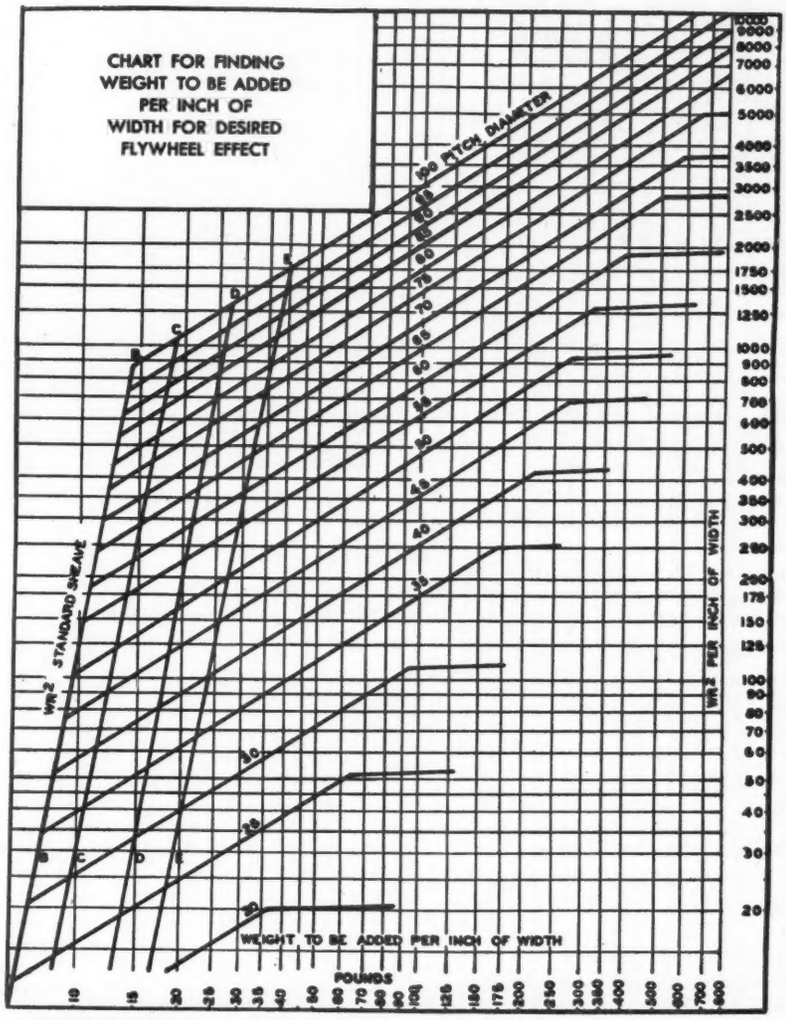
Pointers on Installation

A properly engineered V-belt drive will save much time that otherwise would have to be devoted to maintenance. To cut down maintenance time, it is well to remember the following when installing a drive.

A. All installations should include some means for lateral movement of the motor to permit maintenance of proper belt tension. Slide rails, adjustable motor bases, or idler arrange-

CHART B

Chart for finding weight to be added per inch of width for desired flywheel effect

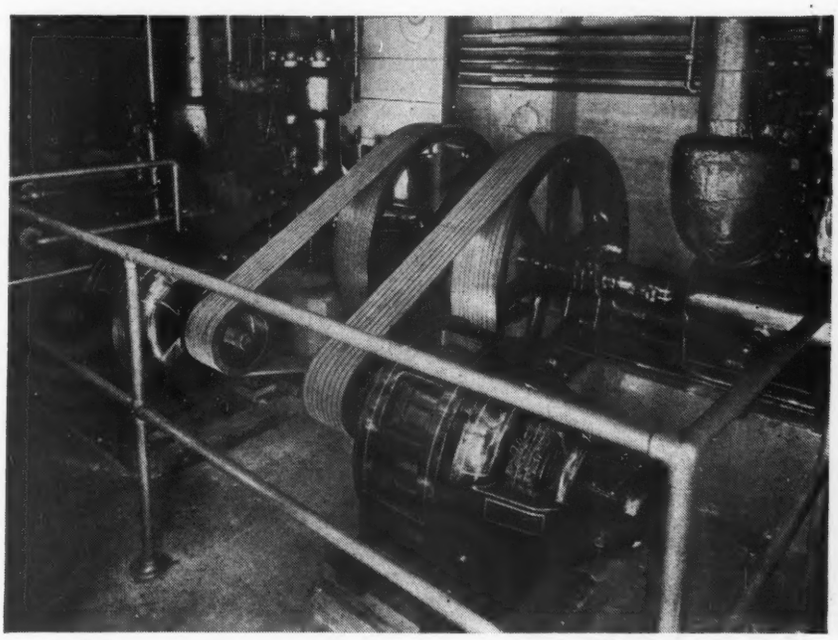


HOW TO USE CHART: Divide the WR required by the face width to obtain WR^2 per inch of face width. Locate this value in the right hand column of this chart, and follow a horizontal line to the left to the intersection of this line and the diagonal, sheave pitch diameter line. Drop a perpendicular from this point to the base of the chart and read POUNDS to be added per inch of face width. POUNDS PER INCH OF FACE WIDTH × FACE WIDTH = POUNDS OF EXTRA METAL

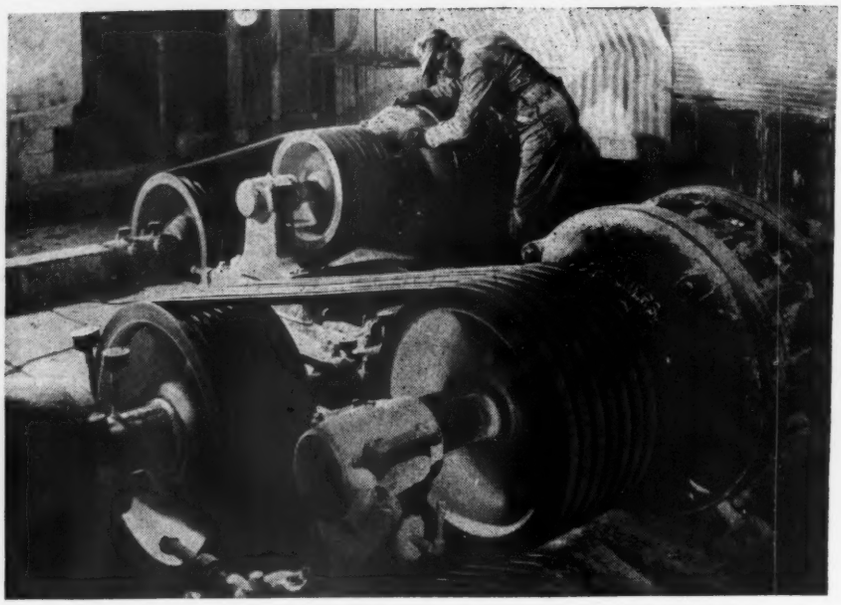
Table IV

GENERAL V-BELT SELECTION TABLE

NORMAL HORSE POWER	MOTOR SPEED			
	1800	1200	900	720 and below
½ to 1½	A	A	A	A
2 to 3	A or B	A or B	A or B	A or B
5	A or B	A or B	A or B	A or B
10	A or B	B	B	B or C
15	B	B or C	B or C	C
20	B or C	C	C	C
25 to 30	C	C	C	C
40	C	C or D	C or D	D
50	C or D	C or D	C or D	D
60	C or D	C or D	C or D	D
75	C or D	C or D	C or D	D or E
100	C	D	D	D or E
125	.....	D	D	D or E
150	.....	D	D	E
200	.....	D	D	E
250	.....	E	E	E
300 and over	.....	.....	E	E



A V-Flat compressor drive using existing flywheel on compressor units.



Compact short-center V-belt drives on stone crusher units.

ments may be used. After the drive is aligned and the V-belts placed in their respective grooves:

1. Back off the motor to obtain a little tension and then turn over by hand.

2. Back off again until all belts appear tight, then run the motor for a few moments to allow the belts to seat properly in the groove.

3. Stop the motor and back off until the belts are snug again. Always allow for lateral take-up to a possible four percent stretch during a belt's operating lifetime so that proper tension may be maintained at all times.

B. All V-belts must be properly aligned to prevent undue belt wear. The driver and driven shafts must be parallel and the belts at right angles to these shafts. A straight edge will aid in obtaining this alignment.

C. Always install a completely new set of V-belts when replacement is necessary. Unless this is done, the new and unstretched belts, having a shorter pitch diameter, will carry the major portion of the load. Under the stress of a severe shock or high starting load, the new belts will be greatly strained or even broken. *V-belts should never be pried off or on a groove with a bar* as this will injure the inner cords and shorten belt life.

D. Installation of multiple belts should always be in matched sets. This choice of matched belts (belts within a set range of inspection numbers) insures equal load distribution on all belts; promotes longer belt life.

E. Never use belt dressing on V-belts, for they depend on frictional contact between the sides of the belt and the groove walls. Belt dressing lessens this friction; causes slip, belt deterioration and short life. Check and replace chipped or badly worn sheaves, as they wear out belts prematurely by acting as grinding wheels.

V-belt Life Expectancy

Five engineering factors determine the life expectancy of all V-belts. They are:

1. Diameters—Depending upon belt thickness, every V-belt has an easy arc. If bent around too small a sheave, the internal friction of the excessive flexing will cook the life out of the belt.

2. Centers—Obviously, the shorter the center distance, the less the belt can stretch. Short centers also save valuable floor space.

3. Number and Size—The number and size of V-belts help to determine the drive capacity, though belt speed does also. Sheave and belt sizes should be sufficiently large to handle the load of the job.

4. Belt Speed—Between practical limits, the greater the velocity of a V-belt, the more horsepower it will transmit. The limits of belt velocity set up by V-belt engineers is 1,000 to 5,000 feet per minute. Below 1,000 feet per minute, horsepower transmitting capacity falls off rapidly. Above 5,000 feet per minute, there is no appreciable gain in horsepower capacity. Use of larger sheaves, therefore, to keep belt velocity in the neighborhood of the upper limit will result in utilization of the fewest belts that will do the job.

5. Contact Arcs—All horsepower ratings for V-belts are based on 180 degree arc of contact with the sheaves. Depending on ratio and centers, this factor will vary from one drive to another and must be carefully considered for each and every drive when determining the engineering data for the installation.

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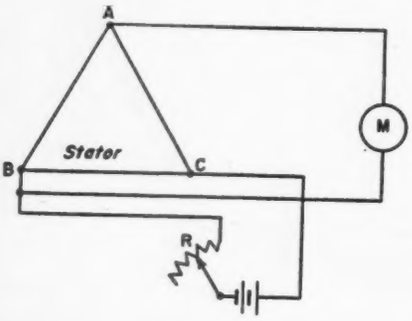
Reader's Quiz

How to Determine Direction of Rotation

QUESTION 299—Is there a way I can determine the direction of rotation of a squirrel cage motor without having to "try"? Often such motors are connected to a load which may not be turned in the wrong direction and I would like to know in advance how to connect the mains to get a certain direction of rotation.—S.V.H.

A. TO QUESTION 299—While this method will not work for a single motor, it will insure that a group all turn in the same direction or a new machine may be compared with an existing installation on the same power source. As shown in the sketch, a



source of low d-c potential is connected across two leads through a resistance and a sensitive voltmeter across the remaining lead and one of the others. The resistance is adjusted until a reading is obtained. Now turn the shaft by hand noting whether the reading tends to increase or decrease. If the same procedure is followed for all motors making sure the shaft is turned in the same direction each time and the meter responds the same, the machines will have the same rotation. If the needle goes in reverse from the one used as a standard of comparison, then reverse two of the stator leads when connecting up the machine. Thus, if S.V.H. has a motor with a known rotation, he can compare new machines by this method and determine their direction with respect to the existing installation and phase rotation.—R.G.A.

A. TO QUESTION 299—If it is not convenient to try motors before they are connected to drive, I would experiment on the machines in question by connecting resistors in series with two of the lines. In this way I would find values of resistors that would just cause motor to turn or take up slack in coupling arrangement. Now for convenience, resistors of the found values could be connected in or to fuse clips, at disconnect switch box, when a connecting job had to be done, and proper connections made.—J.H.G.

A. TO QUESTION 299—A positive method for determining the direction of rotation of an induction motor is with the use of a small "dummy rotor". The "dummy rotor" is inserted in the bore of the stator after the regular rotor has been removed. If the circuit to the motor is energized momentarily, this rotor will rotate in the same direction the motor will revolve when it is reassembled. A "dummy rotor" is a squirrel cage rotor without any iron core. It is made by building a squirrel cage assembly on fibre rings, about two inches in diameter and inserting a rod through the center to act as a shaft. If no rotor is available, a small armature may be used if all the commutator bars are shorted together. This may be done by wrapping two or three turns of bare wire around the commutator. Any rotor inserted in the stator when it is energized must turn in the same direction as the rotating field set up by the winding of the motor.—H.C.S.

A. TO QUESTION 299—A way to determine the direction of rotation of a squirrel cage motor is to apply approximately 10% of full-rated voltage and observe what rotation the motor is trying to turn. Auto transformers with low-range taps is a convenient means of reducing the voltage low enough to observe this effect without permitting the rotor to move. Another method is to run the motor uncoupled from its load and check the phase sequence for whatever rotation is wanted. When the motor is permanently connected, the same phase sequence of the lines must be used to obtain the desired rotation.—R.F.H.

Water in Batteries

QUESTION 300—We have a lot of lead acid type storage batteries in our plant used for emergency lighting, magnaflux, etc. Many times the question has arisen as to the kind of water used. One of the electrical maintenance foremen says that faucet water from the city system is as good and cheaper than distilled water, others say rain water caught in glass dishes should be used or use distilled water. My handbook says to use distilled or approved water. What is meant by approved water? Have any readers had actual experience as to the difference in operation or service rendered by the use of water other than distilled? What is the effect?—R.D.R.

A. TO QUESTION 300—Rainwater caught in glass or earthenware containers is just as safe to use in storage batteries as distilled water and is much cheaper. Of course, the rain water must not be caught from a roof or downspout as that would contain impurities and dirt. I would not advise the use of tap water as the chemicals put in the water at the purification plant are quite injurious to lead acid type storage batteries. Chlorine will cause the positive plates to oxidize much faster than the usual rate.—M.H.S.

A. TO QUESTION 300—Rain can be used if it is not collected from metal roofs. Also, it is not advisable to use rain water that is collected in large cities due to the impurities in the air.

Approved water would be water that has been approved by the manufacturer of your batteries. Most battery manufacturers have a service whereby if you will send them a sample of the faucet water you desire to use, they will analyze the water and tell you if it is permissible to use in your batteries.

I am at the present time and have been using faucet water for the past

A 3 TO 1 ADVANTAGE

TRY ITS ABRASION RESISTANCE, to learn how tough an insulation is. Roevar Magnet Wire shows a three-to-one advantage over standard enameled wires. And such superiority makes Roevar wire your first choice for high-speed winding operations.

Besides its strength and toughness, Roevar Magnet Wire insulation has high dielectric qualities, is extremely flexible, and has exceptional resistance to solvents used in coil-treating varnishes. Importantly, too, Roevar Wire costs less and is of smaller diameter than magnet wire with paper, cotton or silk insulation. It is furnished in sizes No. 14 to 40 A.W.G.

Roebling engineers are anxious to cooperate with you, in helping determine where Roevar Magnet Wire can be used most effectively and to assure best results. Write for full information and samples of the wire.

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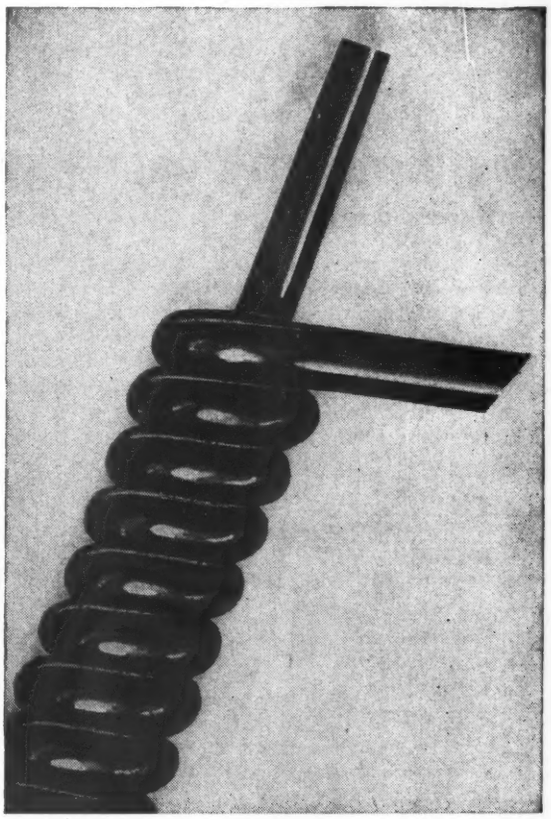

Test shows Roevar Magnet Wire (magnified) wrapped on its own diameter, without appreciable loss in dielectric strength.

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ROEBLING

A CENTURY OF CONFIDENCE

JAR ROEBLING

few years which has been approved by the manufacturer.

I have had very satisfactory results in using faucet water, in lead-acid type batteries for industrial trucks.—D.M.M.

A. TO QUESTION 300—Under no circumstances should you use the water from the city water faucet in the lead acid batteries you have there.

A lead acid battery consists of two sets of plates in each cell. They are composed of a lead grid filled with a paste made of a lead Oxide and are separated by either a thin douglas fir separator or with a threaded glass sheet or both, and are submersed in the electrolite which is of C P sulphuric acid and DISTILLED water to a gravity of between 1250 and 1300 depending on the type of battery. When the battery is first made and the electrolite poured into the jars, there is some of the acid that goes into the paste of the plates and so lowers the specific reading of the electrolite when tested by an acid hydrometer. This is called in a discharged condition. When the battery is put on the charging line and charged up as the saying goes (this charging does not charge electricity into the battery, but produces a chemical change in the plates.) This acid that has combined with the plates is forced out into the liquid acid combination raising the gravity of the electrolite and producing the chemical change in the lead oxide that holds the acid out until the battery is run down by pulling electrical current from it. This is the reason that the water MUST be pure. Any foreign chemical that may be in the water will tend to reduce the capacity of the battery and may ruin it completely.

All water from the city mains will contain a small percentage of iron from the pipes it travels through, and will probably have several more chemicals from the well or stream from whence it came.

Rain water is not a good source of water supply on account of the dust and accumulation of gases in the air that will be washed down with the rain; snow water is in the same category for the same reasons.

The only safe and sound source of supply is from a good distillery where all the foreign matter can be definitely taken from the water, and even then it is necessary to use either glass or pottery or fiber containers in the filling of the batteries.

The worst enemy of the battery is platinum and aluminum, and all of the other minerals have a more or less effect on the life and capacity of the cells of the batteries.

The acid solution in the batteries is of a very corrosive nature and the batteries should be mounted on a good solid foundation of either concrete painted with a good heavy coat of tar and then a rubber mat to prevent leakage of the current, or should be placed on a heavy wooden timber base and the same coating and rubber protection applied to protect the battery from a premature discharge of some of the cells, with a shortened life and more renewal expense.—H.A.G.

A. TO QUESTION 300—Local water usually is of sufficient purity for use in lead acid type storage batteries. This statement is taken from a text book on the care and maintenance of storage batteries; however, before local water is used samples should be submitted to a chemist or to the battery manufacturer for analysis. Why? For this answer it is necessary to delve a bit into simple chemistry to determine the chemical action that would result with the use of impure water. *Some metals replace others from their compound,* and all such metals will replace hydrogen from the sulphuric acid used in lead acid type storage batteries, leaving a sulfate, sulfide, or a mineral salt compound of the metal. A few of these metals listed in the order of their activity are as follows: Potassium, Sodium, Calcium, Magnesium, Aluminum, Zinc and Iron.

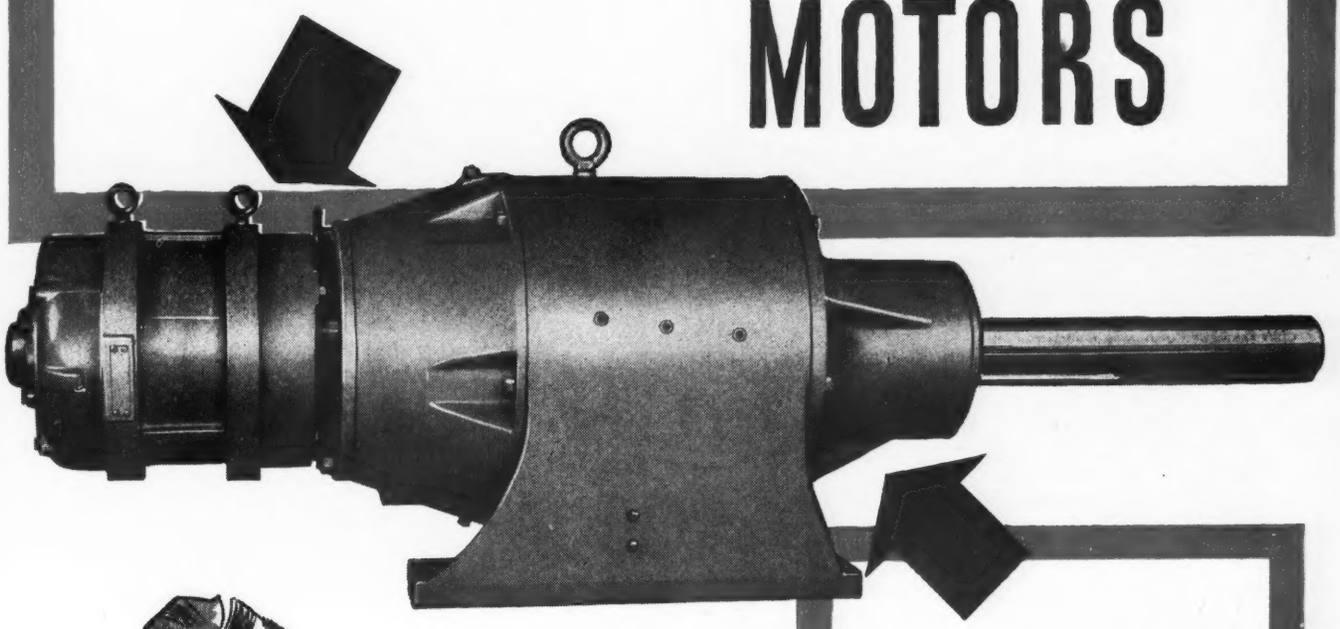
It can be assumed from the above that any of seven common metals or their compounds will decompose sulphuric acid.

Water is the best known solvent. In flowing through and over the earth water takes into solution compounds of such metals to a greater or lesser degree, depending upon the mineral content of the area involved. The compounds of calcium, magnesium and iron are the most common and act quite readily upon sulphuric acid, resulting in a gradual decomposing and weakening of the battery acid. Outside of this objectionable feature, which makes necessary the replacement of the sulphuric acid prematurely, it is believed that no other harm is done to the battery, as the sulfides, sulfates, or metal salts formed are insoluble in water and settle to the bottom of the battery containers with no resultant damage to the lead oxide or lead sulfate, which makes up the positive and negative plates of the battery.

In summing up the foregoing, one may draw the following conclusions: (1) That only distilled water is 100% safe. (2) That rain water is comparatively safe. (3) That local water should be analyzed by a chemist before it is used freely.—J.E.G.

A. TO QUESTION 300—In the maintenance of lead-acid storage batteries, distilled water should be

HOWELL *industrial type* MOTORS



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D. O. JAMES GEAR REDUCER

Why?

Because the motor is an industrial type motor built by Howell and backed by 33 years' experience in building industrial type motors exclusively.

The gear reducer is built by the D. O. James Manufacturing Company, specialists in their field with more than 50 years' experience.

The combination makes an integral packaged unit with the motor flange-mounted to the reducer, yet with a flexible coupling so that motor and reducer can readily be separated for maintenance.

For a modern, economical means of obtaining relatively low speeds from constant speed motors in your business, be sure—buy Howell!

RED BAND MOTORS
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SINCE 1915

For geared motors, motors with unique electrical characteristics, special mechanical form, or standard motors (with any type of enclosure) from 1/6 through 150 HP, consult your HOWELL representative.

HOWELL ELECTRIC MOTORS CO., HOWELL, MICHIGAN

MANUFACTURERS OF PRECISION BUILT, INDUSTRIAL TYPE MOTORS

used exclusively. The use of tap water should be abandoned and rigidly prohibited because of its impurities.

Most cities secure their water either from wells or from streams, lakes, rivers, and other such natural sources. Such water must necessarily contain much mineral matter derived from the soils and rocks, etc. through which it flows. Then many cities use chlorine or fluorine base gases in permanent or emergency purification processes. An analysis (mineral) of ordinary tap water will then of a necessity show that there are dissolved in it oxides, chlorides, sulphates, sulphides, nitrates, nitrides, acetates, fluorides, etc.

Whenever tap water is added to a battery, the acid in the electrolyte will react with the minerals in the water with the obvious result being shorted and buckled plates. This always results in shedding of active material in the battery, increase in internal resistance, loss of capacity, reduction in efficiency, and will cause the battery's temperature to increase with flow of current. This last result will cause the acid in the battery to practically destroy the lead plates. When sulphating becomes so pronounced, the plates will be badly buckled and the internal resistance will be so high that recharging is impossible.

Rain water collected in stoneware utensils is of sufficient purity to cause no trouble, provided it is never stored or subjected to metallic contamination.

Even commercial distilled water must be frequently tested in order to increase battery life. Two chemicals will provide sufficient control; they are silver nitrate and barium chloride. To test distilled water proceed as follows: secure a sample from each container of water on hand, divide sample into two parts and place in different test tubes; in one tube place a few drops of your silver nitrate solution and if there are any chlorides, bromides or iodides present in the water, a precipitation will occur; if nothing happens, the sample has met the first requirement. In the other tube place a few drops of your barium chloride solution and if there are any sulphates present in the sample, a precipitation will occur. If you observed two precipitations, the test was positive and the water should not be used in batteries. If you observed one precipitation, recheck with a new sample. If the result is still positive, do not use the water. If there were no precipitations, the test was negative and the water is of sufficient purity for battery use. Should all tests be positive, return water to the distillery and request an analysis.

All of the above methods of control will result in long battery life, low recharging cost, less maintenance and improved operating results.—H.T.O.

EXPLOSION-PROOF SWITCH PYLETS

1. *TUMBLER SWITCHES with push-pull Rod* to control motors or lighting circuits in hazardous locations. 1 and 2 gang, 1, 2 and 3-pole, 10 to 30 ampere, also 3 way and 4 way, 10 and 20 ampere types.

2. *TUMBLER SWITCHES with interlocking Plug* Receptacle for use as service outlets for portable electrical equipment in hazardous locations. Plugs cannot be inserted or withdrawn unless switch is open. Switch cannot be closed unless plug is fully inserted. 2 and 3-pole, 20 and 30 ampere, 250 and 460 volt ratings.

3. EXPLOSION-PROOF SECONDARY CIRCUIT BREAKER PYLETS for protection of motors against overloads and stalled rotor currents. Can also be used for "on" and "off" switch. Single and double pole with a selection of interchangeable heater units for protecting fractional horsepower motors.

4. EXPLOSION-PROOF UNIVERSAL JUNCTION PYLETS—6, 7 and 10 hub types with close-up plugs. For easy replacement of sheet metal knockout boxes in the rewiring of old gasoline pump installations.

5. EXPLOSION-PROOF JUNCTION PYLETS available in a wide selection of styles and sizes with threaded or union type hub. Furnished with plain covers for general use or with covers tapped for conduit to support lighting fixtures. Also furnished with pipe plug angle type cover for filling with sealing cement.

6. PYLE-O-FLEX flexible explosion-proof and watertight fittings for adjustable and vibrative connections to motors, floodlights and pendant type lighting fixtures. Furnished in any combination of male and female threaded or female union type end connections with flexible lengths of 4 to 36 inches, conduit sizes ½" to 2" inclusive.

7. EXPLOSION-PROOF SEALING PYLETS have removable pipe plug covers which can be mounted in any one of four positions for filling with cement. Used to isolate the wiring compartments of arc-producing devices from balance of conduit system.

EXPLOSION-PROOF UNIONS, male and female, straight and 90° elbow types.

A line of the most commonly used types of conduit fittings for hazardous locations as defined in Article 500 of The National Electrical Code. Explosion-proof Pylets are designed in accordance with Underwriters' Laboratories requirements and are classified in their list of inspected electrical appliances. Their substantial construction and the high quality of materials and workmanship insure safety, uninterrupted service and long life. Consult your Pylet Catalog 1100 for complete listings of the above and other Explosion-Proof and Dust-Tight Pylets.

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Motor Winding

QUESTION 301—Can a motor with coil wound with one coil side or per slot be changed to a winding of diamond coils and two coil sides per slot? This motor is 550 volts 3 phase induction motor 36 slots, 1080 rpm., 2 hp. This motor also uses basket type of winding with coils lying in slots 1-7. The coils are wound in two slots then skips two, then the next two and so on around the motor. Thus, the coils span an even number of coils.—F.L.

A. TO QUESTION 301—The answer to the first part of this question is yes. The method used to figure out the data for the new winding is to determine the total number of turns of your slot and divide by 2. This gives the actual turns to be wound in the diamond coil. The pitch or span remains the same—for example: Assume the motor is 1 to 7 pitch, with coil of 200 turns, you would then wind your diamond coil with 100 turns in each coil and the pitch still is 1 to 7.

The motor will have the same characteristics as the original winding and the wiring connection remains the same.—S.H.

A. TO QUESTION 301—The change from a winding having a single coil per slot to a conventional type of winding can be easily made. The thing to bear in mind is that the number of turns per pole-phase group remains the same. The motor in question is evidently 60 cycle, six-pole, the number of groups being 6 x 3 = 18. Hence, there is one coil per group. The altered winding will consist of 36 coils, each coil having one half the number of turns, and two coils per group. The two coils connected in series will produce the results which you wish to obtain.—L.M.K.

A. TO QUESTION 301—It is easy to change this winding to a standard three-phase diamond coil winding. A simple and practical method is to wind 36 coils span 1-7. Use the same size of magnet wire as in the original coils, but only one-half the number of turns. The original phase connection is used.

I have obtained satisfactory results with the above method; however, if it is desired to change the winding from a design standpoint, the winding distribution factor must be taken into consideration. In this instance, the value of the two-coil distribution factor will be reduced from 1 to 0.966; this means that the number of turns per pole per phase will be: original turns per pole divided by 0.966.—T.B.B.

the Wagner Fractional Horsepower Motor

If you manufacture, install, or service compressors, stokers, deep freeze units, pumps, or any of a hundred different motor-driven appliances—you have a special interest in dependable fractional horsepower motors.

Wagner Fractional Horsepower Motors are the first choice of many manufacturers of small machines and appliances. Millions of these small-sized, low-priced motors have been in use for years, giving troublefree performance and building customer satisfaction. Take a tip from these manufacturers and reduce service calls due to motor failure by choosing Wagner Motors. More than fifty-five years of motor building experience stands behind every motor bearing the Wagner name.

Twenty-nine branch offices, located in principal cities, are ready to assist you, without obligation, whenever you have a motor problem. Write for Bulletin MU-185 for information on the complete line of Wagner Quality Motors.

Type RK

Type RA

Many types and sizes of Wagner Fractional Horsepower Motors are now available from stock.

Wagner Electric Corporation

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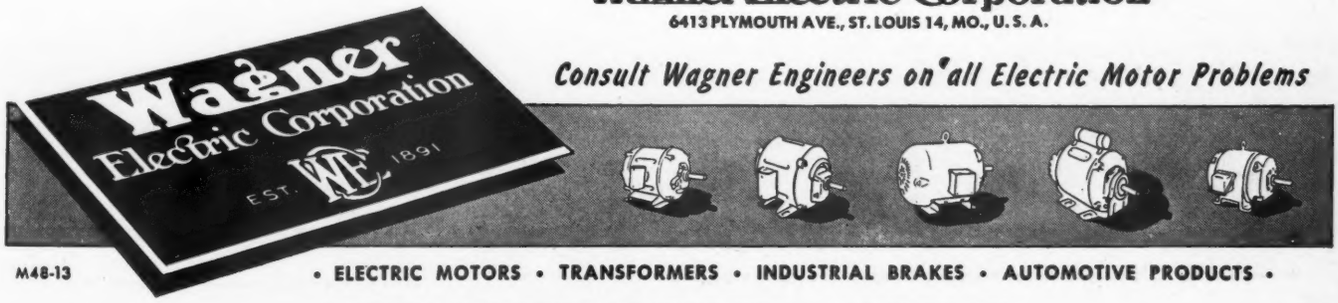
Consult Wagner Engineers on all Electric Motor Problems

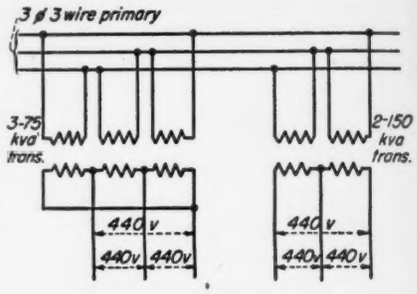


M48-13

• ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE PRODUCTS •

Can you ANSWER these QUESTIONS

QUESTION B14—I would like to know if any of your readers can tell me whether or not the 440 volt secondaries of the following diagram can



be satisfactorily paralleled? Will any harmful circulating current flow? Will the voltage of each secondary be in phase?—A.F.D.

QUESTION C14—I have a 5 hp. slipring motor driving an ammonia compressor automatically through a mercoid switch temperature controller, starting dashpot-solenoid and 3-step cutout of the secondary circuit resistor. This motor is overloaded, and I would like to replace it with a 3-phase 7½ hp. wound-rotor induction motor I have available. What practical hookup can I make to start this 7½ hp. motor automatically under load, if possible by using present auxiliary equipment such as temperature controller, dashpot, resistor, etc.?—G.H.

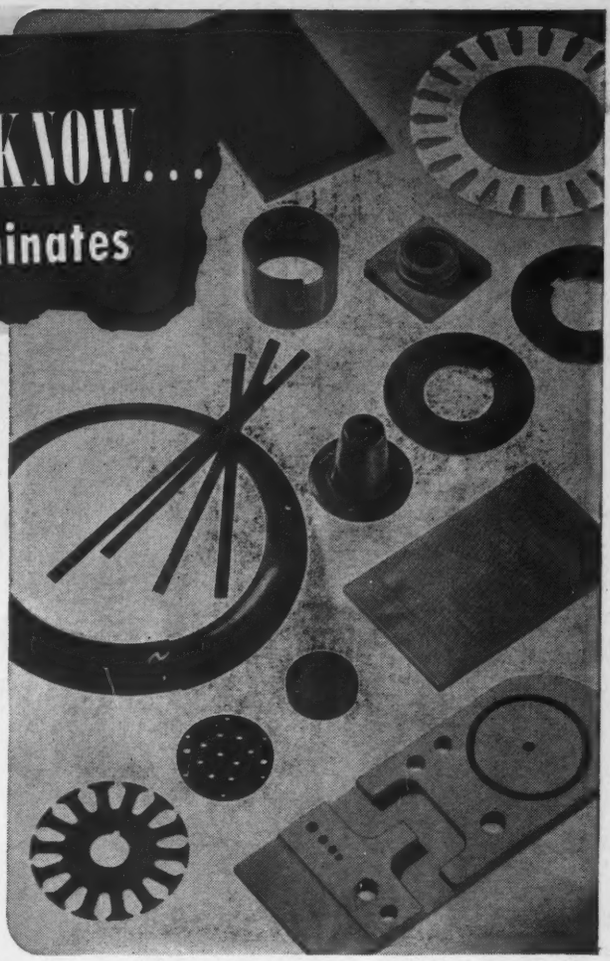
QUESTION D14—Will some one please explain the monocyclic system and its use?—E.J.K.

QUESTION E14—We have a 525 hp., 3 phase, 2300 volt synchronous motor, 100% power-factor, exciting current 79 amperes pulling a mechanical load. Recently the machinery which was being pulled by it broke. Our power factor is low. How much power factor can I safely correct with this motor?—M.D.

QUESTION F14—I have two induction motors, 550 v., 3 p., 1 hp. each, 60 cycle, one running at 1725 rpm., and one at 1720 rpm. It is important that these two motors run in step with each other. What is required in a simple control system to make sure that these motors do not get out of step more than 15 degrees?—H.H.S.

PLEASE SEND IN YOUR ANSWERS BY JANUARY 15

5 FACTS YOU SHOULD KNOW... about Fiberglas-Base Laminates



1 What they are

They are materials possessing a desirable combination of insulating and mechanical properties produced by applying heat and pressure to layers of Fiberglas* cloth or mat impregnated with and bonded by appropriate resins.

Phenolic Laminates. Fiberglas impregnated with phenolic resins . . . offers good physical properties, low moisture absorption and high dielectric strength . . . can be machined and punched.

Melamine Laminates. Fiberglas cloth impregnated with melamine resins . . . possesses very high dielectric strength with extremely low moisture absorption . . . can be machined and punched.

Silicone Laminates. Fiberglas impregnated with silicone, a thermosetting resin having very high heat stability . . . contributes to low dielectric loss factor and low moisture absorption.

Polyester Laminates. Fiberglas impregnated with thermosetting polyester resins . . . good elevated temperature resistance, electrical and mechanical properties . . . complex shapes possible with low-cost tooling . . . excellent machining and punching properties.

2 Where they are used

Fiberglas-base laminates are used for panel boards, slot sticks, transformer spacers, switch bases, terminal strips and boards, insulating washers, coil forms, pole collars, arc shields, etc.

Phenolic Laminates . . . used wherever above average tensile, flexural, compressive and impact strengths combined with good electrical properties are required.

Melamine Laminates . . . used where fire, arc and temperature resistance, and high impact strengths are important.

Silicone Laminates . . . used in electrical apparatus where ambient or operating temperatures are, or might be, excessively high.

Polyester Laminates. . . used where above average temperature resistance and physical properties are required . . . as an excellent general application laminate material.

3 Forms available

	SHEETS	TUBES	RODS
Phenolic	39" wide to 96" long. Up to 2" thick	Up to 6" I. D. in 18" to 48" or special lgths.	Up to 2" diameter. Up to 48" lengths.
Melamine	36" wide to 96" long. Up to 2" thick	Up to 1½" diameter	Up to 4" diameter
Silicone	36" x 46". Up to 1" thick		
Polyester	Flat, up to 36" x 60". 1/32" to 1" thick	Special shapes possible	

4 Who makes them

	Phenolic	Melamine	Silicone	Polyester
Continental-Diamond Fibre Co., Newark, Del.	X	X	X	
The Formica Insulation Co., Cin., O.	X	X	X	
Franklin Fibre-Lamitex Corp., Wilmington, Del.	X			
General Elec. Co., Plastics Division, Chemical Dept., Pittsfield, Mass.	X	X	X	
Laminated Plastics, Inc., Cleve., O.				X
Mica Insulator Company, Schenectady, N. Y.	X	X	X	
St. Regis Paper Co., Panelyte Divn., Trenton, N. J.	X	X		
National Vulcanized Fibre Co., Wilmington, Del.	X	X	X	
Spaulding Fibre Co., Inc., Tonawanda, N. Y.	X			
Synthane Corp., Oaks, Penna.	X	X		
Taylor Fibre Co., Norristown, Pa.	X	X		
Taylor Fibre Co., LaVerne, Calif.	X	X		
Westinghouse Elec. Corp., Trafford, Pa.	X	X	X	

5 Who sells them

. . . electrical distributors and representatives of the manufacturers listed above. If, by any chance, you are unable to locate a supplier, get in touch with the Owens-Corning Fiberglas Corporation branch in your vicinity.

In addition to laminates, Fiberglas-base materials are available in all forms commonly used in the manufacture and maintenance of motors, generators and other electrical equipment. For information on the complete line, write: Owens-Corning Fiberglas Corporation, Dept. 856, Toledo 1, Ohio, for a copy of the "Fiberglas Electrical Insulating Materials" manual. Branches in principal cities.

In Canada Fiberglas Canada Limited, Toronto, Ontario.

*Fiberglas is the trademark (Reg. U.S. Pat. Off.) for a variety of products made of or with glass fibers by Owens-Corning Fiberglas Corporation

OWENS-CORNING FIBERGLAS

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Yarns for use in: Cord • Tape • Braided Sleeving • Cloth • Laminates • Varnished Cloth • Saturated Tubing • Magnet and Lead Wire • Mica Combinations

The Farmer and the Contractor KNEW WHAT THEY WANTED!

THE FARMER WANTED a nonmetallic sheathed cable that would withstand weather extremes—stand up to fumes and corrosive vapors present in livestock houses and dairy barns.

THE CONTRACTOR WANTED a cable for jobs where extra quality is a "must" —a lightweight and flexible cable for easy pulling and clean, fast work.

The result? Super PVX*

Super PVX is a top-quality cable for those difficult jobs where easy installation and long service under the worst conditions are important. The tough, rotproof thermoplastic insulation and reinforcing glass braid result in smaller over-all dimensions and substantial reduction in weight.

Super PVX
NONMETALLIC SHEATHED CABLE

The smooth, durable thermoplastic rotproof sheath is available in ivory or brown color, to give trim, neat appearance on surface wiring jobs. And, it's as tough as it is good looking, to provide ideal protection from abrasion, moisture, flame, corrosive vapors, and fumes. It is approved by Underwriters' Laboratories, Inc.

For samples, see your General Electric Construction Materials distributor, or write to Section W6-1218, General Electric Company, Bridgeport 2, Connecticut.

GENERAL ELECTRIC

AROUND THE CIRCUIT with your GE Merchandise Distributor

STILL DOING A GOOD JOB is PVX nonmetallic sheathed cable. This cable is light, small in diameter, and more flexible than conventional cables. These features are the result of skilled engineering in cable construction. They are built into PVX to give you easy handling, to speed installations, and to keep PVX on the job after it is installed. Let us give you more information on this outstanding cable. You'll find many uses for it.

DON'T WORRY ABOUT OIL—General Electric's Type TW wire doesn't. This thermo-plastic building wire has the ability to resist oil year after year, even when immersed in it. And, it's equally unconcerned about moisture and most chemical vapors or fumes.

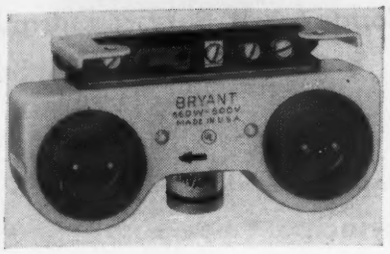
EASY INSTALLATION—This service entrance cable can normally be installed exposed directly on the outside of the building. Service entrance cable is one of many items described in the new General Electric catalog, *Building Wires, Cable and Cords for every purpose.* If you would like a free copy, write to Section W6-618.

DON'T OVERLOOK this sales potential—The next time you call on an industrial customer, look around and you'll notice dozens of uses for Flamenol* cords. Notice the variety of equipment that requires replacement cords. It's a good way to pick up extra business . . . and add to your volume and profit.

General Electric also makes rubber-jacketed cords in many sizes and constructions. They're built for long service and outstanding performance. Ask us about Flamenol or rubber-jacketed cords; we'll be glad to tell you more about them.

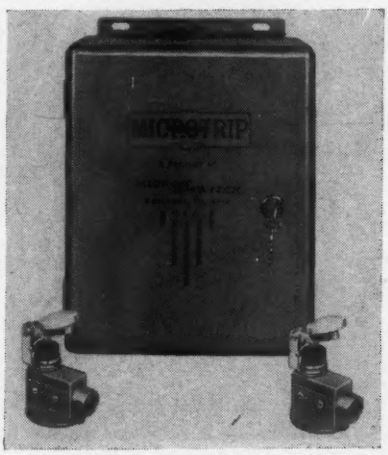
*TRADE-MARK REG. U.S. PAT. OFF.

Equipment News



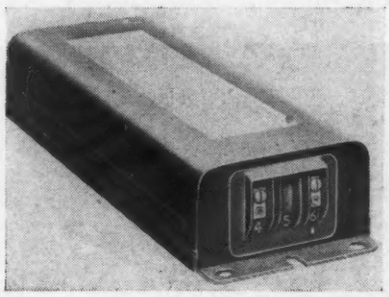
Lampholder

A new duplex push contact fluorescent lampholder for use with standard bi-pin lamps is available. It features Beryllium copper contacts; molded bakelite terminal block with terminal screws located on front; spring actuated molded bakelite discs which operate in guides and assure good electrical contact between lamp pins and lampholder contacts; neither vibration nor shock can displace lamps. Device is listed as standard by Underwriters' Laboratories. Bryant Electric Company, Bridgeport 2, Conn.



Safety Trip Unit

A new electrical control device called Microtrip for two-hand operation of punch presses, riveters, spot welders and similar power-operated machines. Keeps operator's hands out of way during operating cycle, increases production by reducing operator fatigue. Special-bridge type electrical tripping circuit requires simultaneous hand switch pressure of only 10 to 18 ounces to operate machine. Pressure on single switch, or attempt to tie down either switch or lock reset button on control box "kills" tripping circuit and prevents machine operation. Tripping circuit must be reset by hand, once opened. Unit can be installed on existing equipment; comes in various sizes and designs to suit different types of machines. Micro Switch Division, First Industrial Corporation, Freeport, Ill.

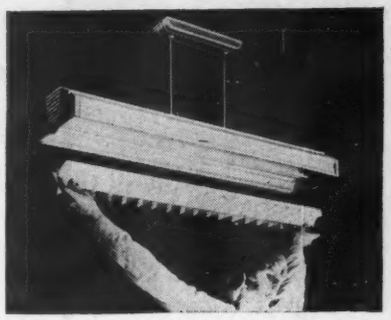


Lamp Ballast

A new line of leadless, terminal-board ballasts for slimline fluorescent lamps has been announced. New ballasts are available in three Tulamp ratings: 300 ma. operation of either the 64T6 or 72T8 lamp, 200 ma. operation of the 96T8 lamp, and 300 ma. operation of the 96T8 lamp. Shorter in length, they feature reduced noise level and watts loss. Screw-in clips on terminal board located at one end of the ballasts eliminate the need for soldering connections. General Electric Company, Schenectady 5, N. Y.

Blacklight Lamps

These blacklight lamps called Raymaster, are essentially low pressure mercury arcs. They furnish a source of long wave ultraviolet or "blacklight", filtered to remove all but a trace of visible light. The principal application of these lamps is to excite manufactured fluorescent pigments and materials, and also natural fluorescent materials used in many industrial and professional fields. Energy peak is close to 3600 Angstrom units. Lamps require auxiliary operating equipment such as ballast, lamp starter and holders. Available in 4, 6, 8, 15 and 30 watt. George W. Gates & Co., Inc., Franklin Square, Long Island, N. Y.



Lighting Fixture

A new fluorescent lighting unit for use in schools, libraries, public buildings and institutions has been announced. It is constructed of metal. Feature of the contoured louver is its special locking and hanging principle that simplifies maintenance. The flick of a finger releases the lock, allowing louver to slide down into an open position on two slotted hangers, and permits relamping and cleaning. Top reflector rails are removable for immersion washing. It may be flush or suspension mounted, individually or in continuous rows. It uses the E.T.L. approved brick type ballasts. Operates on 110-125 volts 60 cycle a-c. Unit carries Underwriters' Laboratories approval. Mitchell Manufacturing Company, 2525 Clybourn Ave., Chicago 14, Ill.

Transformers

The addition of 25 and 37½ kva. transformers to this line of CSPB units for banked-secondary operation has been announced. Better voltage regulation with the high proportion of motor load required by typical residential and commercial load can be obtained by paralleling the secondaries of a group of CSPB transformers supplied from the same primary feeder. Proper coordination among these larger transformers in case of overloads or faults on secondary is provided by newly developed, high interrupting capacity, type BR secondary breakers built into the transformers. A faulty transformer will be completely isolated from the system by the combined operation of the primary protective links and the secondary breakers. Westinghouse Electric Corp., Pittsburgh 30, Pa.

Fittings for

• **Thinwall Conduit** • **Rigid Conduit** • **Metallic and Non-Metallic Cable** • **Flexible Steel Conduit** • **Service Entrance Cable** • **Grounding Devices** • **Lighting Fixture Fittings**

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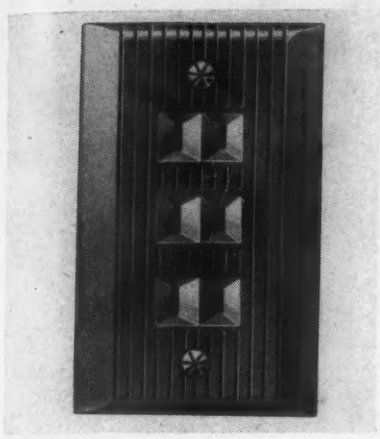
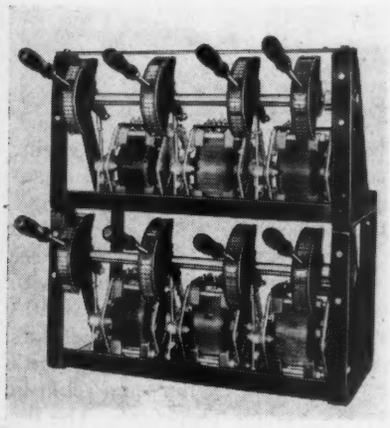


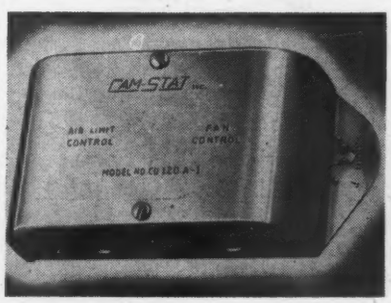
Switch and Outlet

One piece assembly of the three way switch and triple outlet eliminates dust catching space between device and plate. Unit can be quickly installed, two screws mount the device, and gang in any combination. Flush mounting is automatic; oval screw holes permit accurate squaring. "T" rated switch has tapered handle. Trigger guard is molded on plate. Double-sided spring bronze contacts in each of the three outlets hold plug securely. Housings for switch and outlet are of heavy molded plastic, available in brown and ivory. Both units are Underwriters' listed and meet REA as well as Federal specifications. Monowatt Incorporated, Providence, R. I.



Dimmers

A new line of interlocking Powerstat dimmers for incorporation in switchboards has been announced. They are of the continuously variable auto-transformer type. Two ratings are available. One has an output range of from 0 to 1700 watts; the other from 0 to 4600 watts. Both ratings are offered in five assembly arrangements. Form "A" consists of dimmer, ready for switchboard mounting, with shafting and tension mounting blocks only. Form "R" has a gear and gear segment attached to turning shaft. Form "H" has gear, gear segment, linkage, drum and operating handle. Each dimmer of Forms "A", "R" and "H" control one circuit. For control of more circuits, dimmers are coupled by shafting and can be individually controlled or mastered for group control. Any number of units up to ten can be mounted in the bank. Lamps may be dimmed from full-on to black-out regardless of number of lamps in operation. Superior Electric Company, 655 Hannon Avenue, Bristol, Conn.

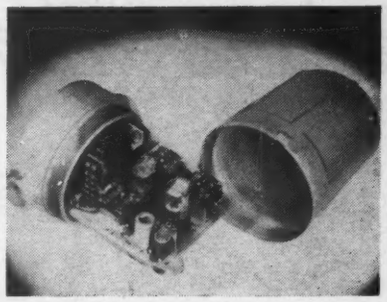


Furnace Control

A new single-unit furnace control, that does double duty as air limit and fan control has been added to this line. Dimensions are $5\frac{3}{8}$ in. by $2\frac{7}{8}$ in. by $2\frac{1}{4}$ in. Ratings of both controls are identical: 1500 volt amp., $\frac{1}{4}$ hp. and 125 volt amp. pilot duty at 120-240 volts a-c. Also available for low voltage air limit control applications. Total range of the air limit control is 100-200° F., with a 10-degree differential; removable screw stop limits top temperature to the 200° F cut-in temperature, with a 15 degree differential. Cam-Stat, Incorporated, 2310 South La Cienega Blvd., Los Angeles 34, Calif.

Lead-In Supports

A series of lead-in supports that eliminate two major causes of television black-out, FM fadeout has been announced. Available for all popular types of lead-in cables, they not only provide a rigid support for the lead-in wire, preventing it from twisting in the wind or going slack, but stop short circuits by giving quick moisture drainage at support, yet holding wire firmly without injury to the insulation. They are resistant to weather extremes, will not expand or contract allowing conductor to slip or crack insulation. They are constructed with a positive "alligator" pressure grip which holds lead-in wire taut without cutting or chafing. Porcelain Products, Inc., Findlay, Ohio



Electronic Control

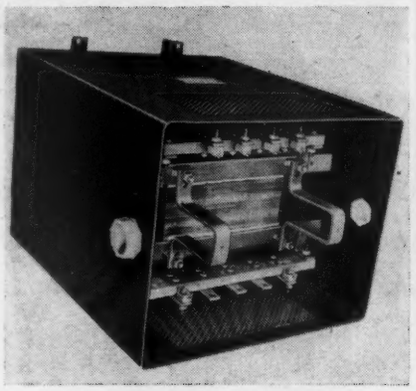
A new electronic load control, known as Flex-I-Trol, for use with all motor-operated processes such as pulverizers, pumps, extruders, etc. is available. It maintains a constant motor load by regulating the input feed. Variable time delays and a variable dead zone are incorporated to eliminate hunting and to insure operation at maximum output. One model suitable for motors of all ratings is provided. It employs two identical radio type vacuum tubes and operates from 115 volts, 60 cycles. Available in either explosion-proof or standard sheet metal housings. G. C. Wilson & Company, 2 N. Passaic Ave., Chatham, N. J.

Electronic Lamp

A new electronic lamp, type A-H12 or B-H-12, utilizing cadmium and mercury vapors has been developed. Lamp has been designed chiefly to simplify the problem of lighting movie sets and television studios by minimizing excessive heat and by providing, watt for watt, twice as much illumination as was obtained previously with incandescent spotlights and floodlights. Characteristics of the lamp are as follows: watts, 1000; outer bulb, T-28; arc length 5 inches; base, mogul screw; initial lumens, 60,000; maximum overall length, 14 inches; light center length, 9 inches. Westinghouse Electric Corp., 306 Fourth Avenue, Pittsburgh 30, Pa.

Explosion-Proof Motor

Totally enclosed fan-cooled motors in the 736 frame size are available. Ratings of 200 hp. at speeds of 3500, 1750, 1160 or 870 rpm., 550 volts or less, and 150 hp. at the same speeds for operation on 2300 volts. Motors are approved by Underwriters' Laboratories for Class I Group D and Class II Groups E, F and G hazardous locations. Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis 14, Mo.



Transformers

Two types each of single phase and three phase dry-type distribution transformers, for providing specific voltages where required for auxiliary lighting and power circuits, have been added to this line of transformers. Two-winding dry-type transformers are built as single phase Type AE, in sizes 250 kva. to 200 kva., and as three phase type AP in sizes 3 to 300 kva., in the 600 volt class and below. Dry-type auto transformers are built as single phase type AA, in sizes 500 va to 25 kva., and as three phase type AM, in sizes 5 to 50 kva., both types 240 to 240/120 volts. All have class A insulation, and are rated 55° C rise continuous duty. Construction of single phase, two winding units through 10 kva., and of single phase auto transformers through 25 kva. makes these ratings suitable for either indoor or outdoor installation. Wagner Electric Corp., 4400 Plymouth Avenue, St. Louis 14, Mo.

Power Plants

New gasoline and diesel engine driven power plants have been announced. Available in a-c output, single or three phase, 50 or 60 cycle, and in sizes from 5 kw. to 60 kw. Each set is self-contained and equipped with controls, radiator, fuel tank and weatherproof canopy. The a-c generators are of the revolving-field type and with direct-connected exciter and built-in automatic voltage regulators. The d-c generators are of the compound-wound interpole type and available in any size, 5 kw. through 60 kw. The a-c or d-c generators up to 25 kw. are available with gasoline engine, whereas units with 20 kw. through 60 kw. ratings have diesel engines. They are designed for stationary, portable or standby service. They will furnish light and power for schools, hospitals, hotels, resorts, airports, utilities, industries, construction jobs, etc. Motor Generator Corporation, Hobart Square, Troy, Ohio.

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The Hazaprene tough jacket is an especially formulated compound that brings out the optimum physical properties of its basic ingredient: neoprene. This jacket successfully resists oil, grease, solvents, acids, water, sun, flame, etc. And just as important, it withstands twisting, heavy blows, scraping, stretching, and other possible mechanical damage.

The extra-flexible conductors are made of soft annealed copper, tin coated for ease in making soldered connections. Insulated with a Hazard rubber compound that's strong, flexible and long-lived, Hazacord assures you excellent electrical as well as mechanical protection.

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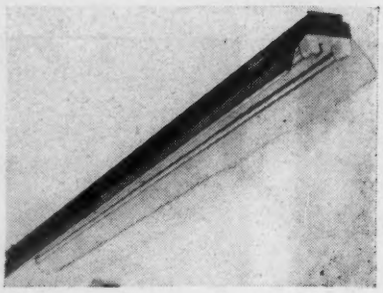

Fluorescent Unit

A new slimline Silv-A-King fluorescent industrial unit, suitable for heavy duty, has been introduced. Top channel is one piece, heavy gauge steel, finished in gray baked enamel to match top side of reflector. Slide-grip hanger groove runs entire length of unit. It also features the E-Z lok; G-E slimline lampholders; and new safety spring action that keeps lamps from falling because of vibration. Unit carries Underwriters Laboratories approval. Bright Light Reflector Company, Fairfield and State Streets, Bridgeport, Conn.

Control Station

A new shipper rod operated control station, specifically designed to meet the needs of the textile industry, has been announced. Right or left hand operation in either clockwise or counter clockwise direction can be obtained from this one device. A slotted operating arm, enables proper linkage adjustment to give correct shipper rod "throw". It uses two precision snap-switch mechanisms enclosed in non-carbon tracking melamine cases. Contacts are double break, silver-to-silver, and non-overlapping. Enclosures are available in NEMA Type I general purpose and NEMA Type IV watertight construction. Square D Company, 4041 N. Richards St., Milwaukee 12, Wis.

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Color	Tan
Adhesion	Satisfactory
Penetration 77/100/5	0
Chloride Free	Yes
Spec. Grav.	1.55
Flash Point	450° F

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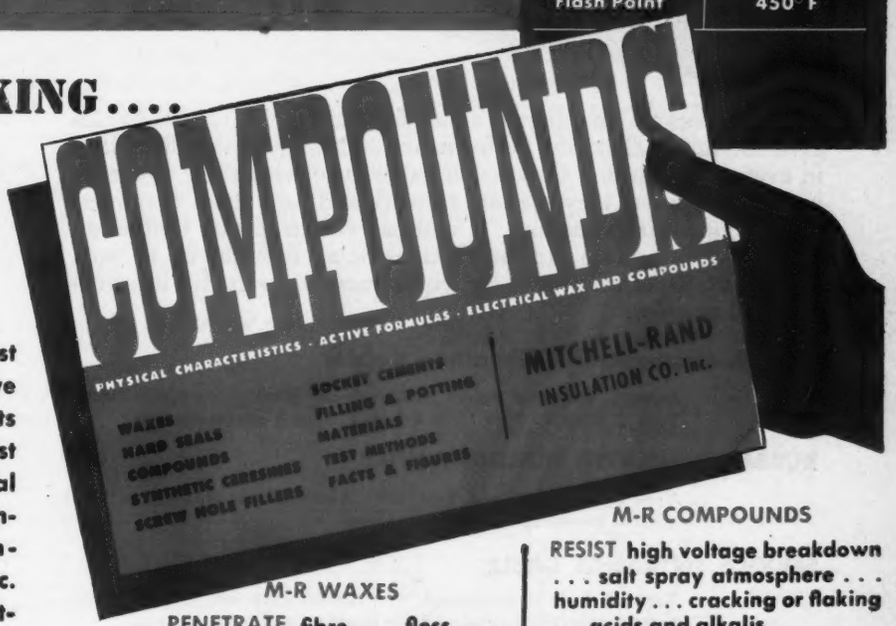

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Outlet and Caps

A new grounding type convenient outlet designed for grounding exposed metal parts of portable appliances has been introduced. This 3-wire outlet has two current carrying contacts and one grounding contact built into device. The grounding contact is electrically connected to the yoke and also to a terminal on the side of the outlet to which a grounding conductor may be connected. The binding screw of terminal is hexagonal-shaped and colored green for identification. In metallic system wiring, the grounding is made directly through the metal enclosure. For non-metallic systems, the grounding is completed through a third wire serving as a grounding conductor. New type 3-wire caps are provided with a grounding blade. When desired, outlet can be used in conventional manner to accommodate standard 2-pole or tandem blade caps, and can be either back or side wired. They carry Underwriters approval. The Bryant Electric Company, Bridgeport, Conn.

Magnetic Starters

A new line of Bulletin 4130 a-c combination magnetic starters with circuit breakers has been developed. These newly designed starters fulfill N.E.C. requirements for motor branch circuit overcurrent protection, disconnect means, motor running overcurrent device and motor controller. Each starter consists of a magnetically operated contactor with thermal inverse time delay overload relays combined with a thermal type circuit breaker, the devices being housed in a NEMA Type I enclosure. Externally operated from the front, all circuit breakers have provision for padlocking in the "Off" position and are interlocked mechanically to prevent opening enclosure door when breaker is "On". Available in five standard sizes to 200 hp., 3 phase, 550 volts, 60 cycles maximum. Ward Leonard Electric Co., Mt. Vernon, N. Y.

Angle-Head Attachment

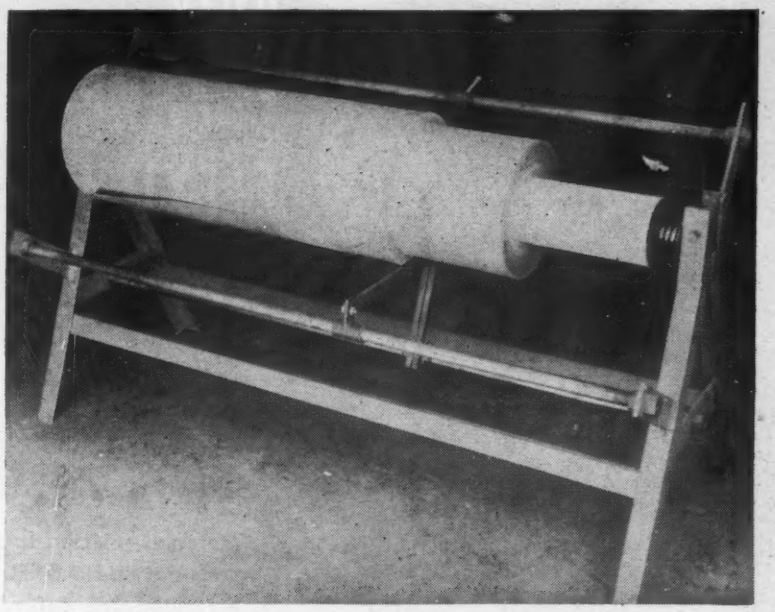
A new angle-head attachment to drill at right angles with an electric drill and get in the hard-to-reach places has been announced. A specially designed $\frac{1}{2}$ inch Jacobs chuck fits the bull buffer, which in turn fits the chuck of any electric drill. Bull buffer's gear reduction adds power to the drill, reduces its speed so that $\frac{1}{2}$ inch drilling in wood or steel can be accomplished without injury to the $\frac{1}{4}$ inch drill. F. E. Bertram Engineering Co., 3121 Main St., Kansas City, Mo.

Motor Shops

Roll Paper Cutter For Strip Insulation

Long strips of kraft or fishpaper are generally required for insulating between layers of windings on field coils and transformer coils. At the Power Electric Company, Jackson, Miss., this paper is purchased in large wide rolls and cut to the desired width and length for specific rewind jobs. To speed up this operation, D. C. Nix of the Power Electric Company designed and built a device that cuts the paper to the preset width while it is being unwound from the wide roll.

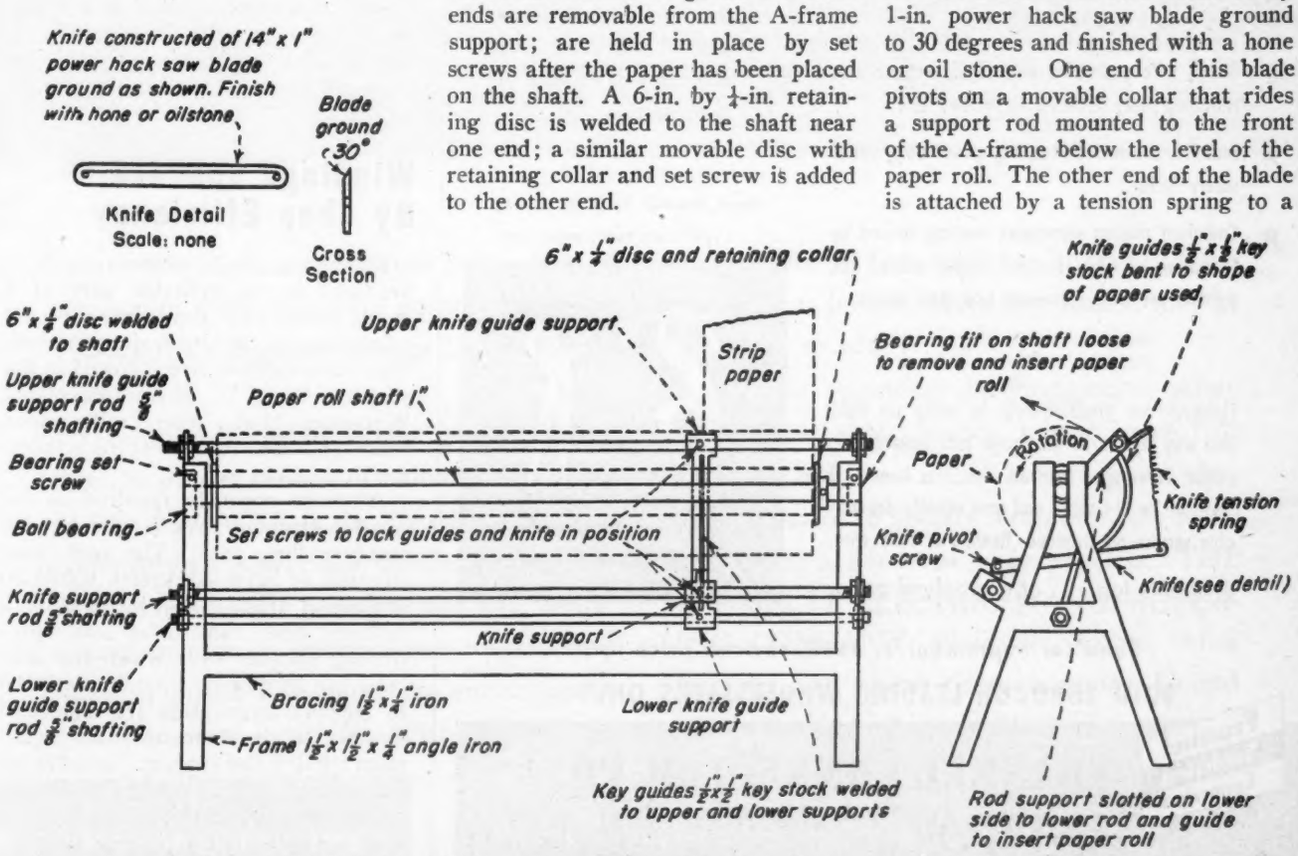
The design was entered in the 1948 NISA Awards Contest and is released for publication through the courtesy of the 1948 Awards Committee of the National Industrial Service Association.



Roll paper cutter slits insulating paper to desired widths as strips are unwound from wide roll. Strips are rewound on spool attached to winding machine spindle.

A long A-frame made of 1½-in. by 1½-in. by ¼-in. angle iron (length depends upon widest paper to be used in shop) supports a 1-in. diameter shaft on which the roll of paper is mounted. Ball bearings on the shaft ends are removable from the A-frame support; are held in place by set screws after the paper has been placed on the shaft. A 6-in. by ¼-in. retaining disc is welded to the shaft near one end; a similar movable disc with retaining collar and set screw is added to the other end.

The paper cutting device consists of a knife blade made from a 14-in. by 1-in. power hack saw blade ground to 30 degrees and finished with a hone or oil stone. One end of this blade pivots on a movable collar that rides a support rod mounted to the front of the A-frame below the level of the paper roll. The other end of the blade is attached by a tension spring to a



Construction and design details of roll paper cutter. Frame dimensions are omitted since unit can be built to accommodate any width of paper normally used in a shop.

similar collar that rides a second support rod mounted to the frame slightly above and behind the paper roll. Also welded to this upper collar is a sickle-shaped knife blade guide bent to conform to the shape of the paper roll. Two sections of ½-in. by ½-in. key stock comprise the guide. The knife blade rides between them. The lower ends of the blade guide are welded to a collar that rides a separate guide rod paralleling the knife support rod. Set screws in each movable collar lock the cutting mechanism into pre-determined positions for proper paper width.

To insert a roll of paper, the set screws on the upper and lower guide supports are loosened and the upper guide support rod is removed. This lowers the cutting blade. After loosening the bearing set screws, the paper roll rod is removed; also the movable retaining disc. After the shaft has been placed through the paper roll, the retaining collar is replaced; the shaft is mounted to the frame and bearing set screws tightened. After replacing the upper guide support rod, the knife spring is detached. The blade and guide support collars are then moved along the rods to the desired paper width, locked in place, and the blade tension spring replaced.

The device is now ready for the cutting operation. As the roll is turned in a counter-clockwise direction, the paper is cut and the strip wound on a spool attached to a winding machine spindle. Tension of the cutting blade spring is adjusted for paper thickness and cutting speed.

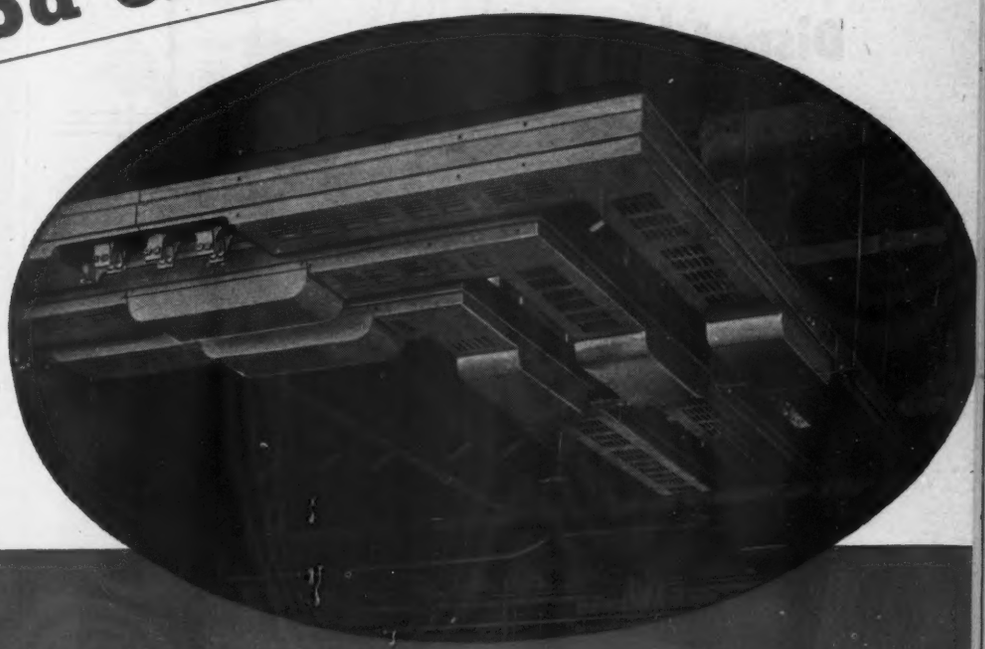
Windings Speeded By Shop Efficiency

Rewinding small motors can be a headache or a profitable part of a motor repair shop, depending upon the efficiency of the methods practiced. Two such methods are followed in the shop of Alfred L. Brown Associates, Worcester, Mass., where rolling wire racks and rotating armature winders are in constant use.

All wire normally required in the small-motor shop area is carried on a sturdy rolling rack. The rack, constructed of plywood sheets bolted to angle-iron frames and inclined on a castored base, consists of many protruding spindles over which the wire reels can be placed. Spindles designed to support large reels are connected directly to the framework for maximum rigidity and support. Spindles for smaller and lighter reels are positioned on the plywood sheets. Since the rack may be rolled easily, it may be positioned adjacent to various machines as needed. Wire is kept in a neat con-

It's good electrical practice...

to use low voltage drop busways for carrying heavy currents long distances.



It's good Electrical Practice...

to provide for future changes in location of equipment with a *flexible* busway system — Trumbull LVD (Low Voltage Drop) FLEX-A-POWER.

Designed to hold down power losses through precise control of voltage drop, LVD FLEX-A-POWER is the flexibly efficient artery of your power distribution system. It is shipped completely prefabricated and, hence, is easy to install. Standardized construction makes it possible to move the entire feeder system to new locations. With sections no longer than 10 feet, cable tap boxes are easily installed at joints to feed any load it may be necessary to add.

Main or secondary feeder systems, safety switches or switchboards, motor control or control centers . . . it's always good electrical practice to specify Trumbull, the name that safeguards *your* safe practice. THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn. Other factories and offices throughout the United States. Foreign representation.

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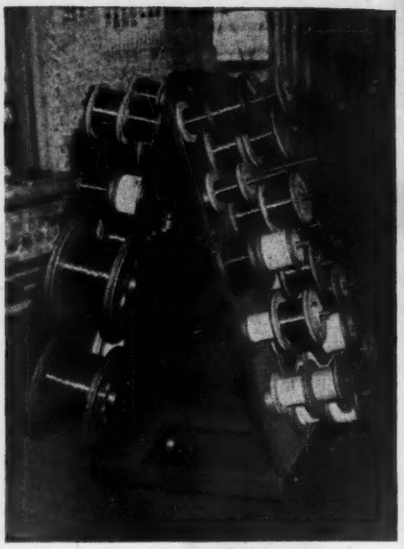
TRUMBULL (T) ELECTRIC

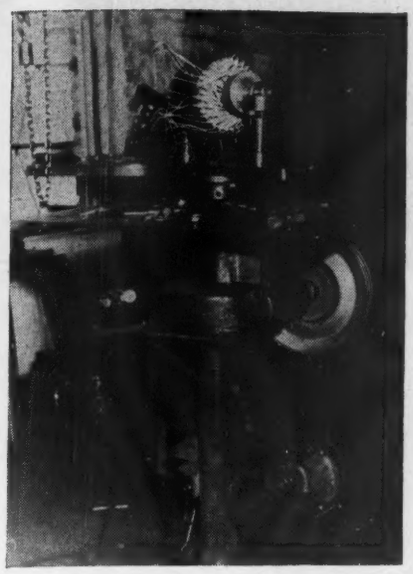


Wire reel rack rolls on castors and can be moved around shop as desired. Frame of angle-irons is faced with plywood sheets. Reel spindles are connected either to the framework or plywood depending upon the size and weight of the reels to be supported.

Rotating winders support armatures with shafts in horizontal plane. Armature can be rotated about its shaft by gentle hand action while entire unit revolved end-for-end by motor drive.

dition, kinking is eliminated, runs between reel and winder are reduced and shop personnel claim that the unit is a definite time-saver.

The rotating armature winders revolve in a horizontal plane through motor action, and in a vertical plane when turned by hand. The speed of the drive motor can be regulated by a small rheostat, and the power transmitted to the revolving winder shaft can be adjusted by means of a foot-pedal sewing-machine tension belt assembly. With the armature being rewound supported so that its shaft remains horizontal, the combination of hand and motor action results in the armature spinning end-for-end and also around its shaft. The operator can

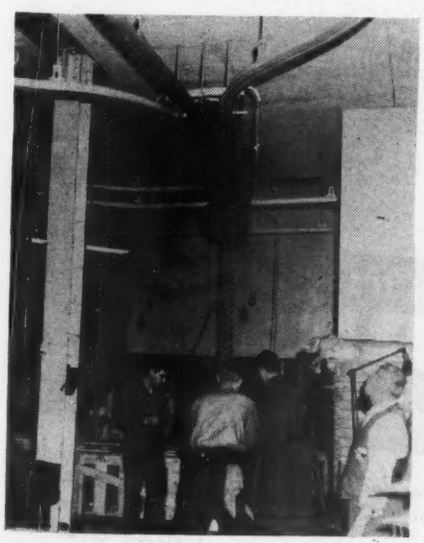


Rotating winder is turned by vertical shaft, gear-connected to pulley which is belt-driven by rheostat-controlled motor.

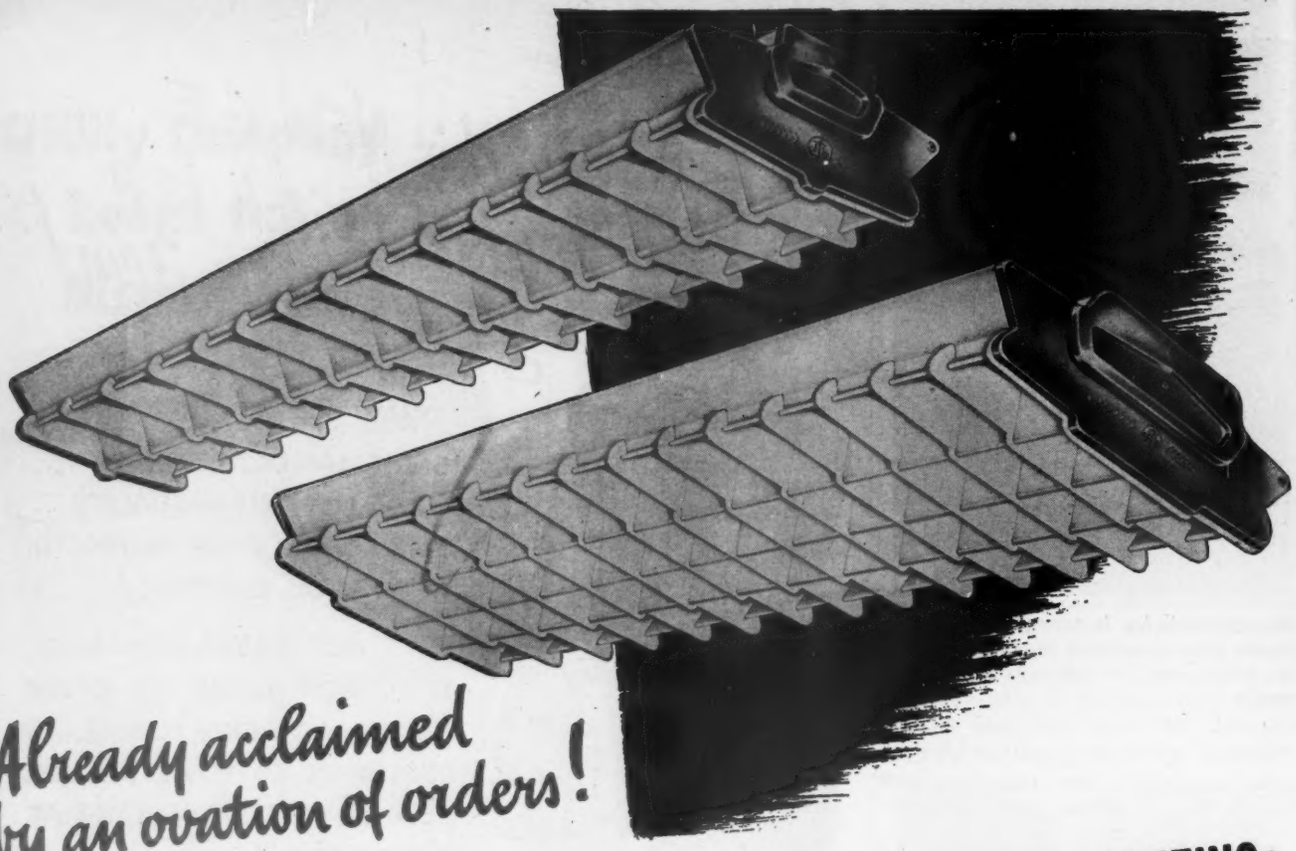
therefore lay wires in the correct slots with only slight hand movement and obtain savings in time and material.

Monorail System Serves Entire Shop

An overhead monorail system, designed and constructed in the motor repair shop of the L. and P. Electric Company, Brooklyn, N. Y., serves the entire shop area and projects to the loading areas. As indicated in the accompanying view, the rail system makes it possible to serve all areas by merely switching the 2-ton traveling chain-hoist to the proper segment. Switches are chain operated, activated by manual control. Hangers connect rails directly to ceiling structural beams and the system gives complete coverage of the floor area.



All areas of repair department are serviced by elaborate monorail system.



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Modern Lighting

Light colored floors, machines and ceiling aid fluorescent reflectors in providing . . .

Ideal Lighting In Tool Plant

The mass production of small precision mechanical tools requires illumination which will permit precision seeing. This fact was taken into account by the architects and owners of the modern one-floor plant of Sterling Tool Products Company, Melrose Park, Ill., when they planned the lighting. They also recognized that lighting, to be adequate and comfortable, embraces more than the selection of light sources, and reflectors, and the spacing of the lighting units to give uniform footcandles over the area to be lighted. They recognized that lighting for comfort also includes the selection of paints and finishes for all surfaces in the normal field of view which will produce proper brightness ratios for maximum ease of vision.

The Sterling Tool Product plant covers an area of approximately 35,000 square feet. It is of exposed steel roof truss design. All mechanical facilities, such as sprinkler lines, heating pipes, electrical conduit and bus work are installed exposed overhead.

In order to "light condition" the interior, the entire ceiling including the mechanical facilities were painted in light color, with a reflection factor of 75 percent. A natural color light concrete floor was installed, having a 35 percent reflection. In addition, all machines were painted in light colors, to provide greater safety and better seeing conditions, and to promote shop cleanliness.

The lighting system consists of continuous rows of two-lamp fluorescent industrial reflector units with 40-watt 3500-degree white lamps. These continuous-row reflectors are suspended from messenger cables at a height which would permit the units to clear the underside of the steel beam ceiling construction. The continuous rows are spaced 10 feet 2 inches on centers.

The continuous rows are formed by locking together the bodies of individual reflector units. Circuiting is done through the units themselves. Individual reflectors are independent of each other, and hinged to the bodies. This construction permits quick and easy access to any individual ballast or the wiring, and facilitates maintenance.

The lighting result is a uniform intensity of 50 footcandles on the horizontal plane at machine tool level. The combined effect of well distributed illumination with light clean floors, light color machines, white ceiling and other construction, is one of excellent seeing conditions. These same features combine to encourage high standards of cleanliness and orderliness.

By using a system of overall general lighting, it permits of rapid rearrangement of production facilities for product design changes, or for improved production methods.

This plant reflects coordinated plant design, illumination design and painting which contributes to optimum seeing conditions and employee comfort.

Architects for this project were the Clearing Industrial District, Inc., Chicago. The Crescent Engineering Company, Chicago, were the electrical contractors. Lighting Products, Inc., Highland Park, Ill., furnished the lighting equipment.

Lighting Considered For Color Values

The correlation betwen illumination, architecture and decoration is tangibly evident in the treatment of the banking space in the Home Savings Bank, Boston, Mass. Confronted with an irregular floor area and the presence of many structural columns, considerable thought preceded actual construction, with the result that the completed installation combines dignity with distinction. Natural wood veneer panelling was selected for walls and column sheathing, giving richness while suggesting the massive trees of the early surrounding forests. Connecting these columns with ceiling-mounted rows of light, two and three-lamp 40-watt fluorescent luminaires furnish diffused, general illumination. Acoustical ceiling tiles soften the normal sounds of business, while a mural depicting familiar scenes of Colonial Boston grace the curtain arch which separates the public area from sections occupied by bank officials and secretarial personnel.

The color value of the lighting plan was fully appreciated by the mural painter, who insisted that the lighting installation should be in operation prior to the rendition of the murals. Although the fact is generally acknowledged that colors will assume varying esthetic qualities when viewed under various types of lighting, it is rare that this fact is considered in modern construction, and the instal-

Lighting installation in Boston's Home Savings Bank was completed before wall mural was begun, insuring true color values of Colonial Boston scenes. Irregular floor area and structural columns are tastefully decorated with veneer sheathing.

lation of the Home Savings lighting plan, before the interior was completed, created much favorable local comment from decorators and lighting men alike. Selection of fixtures and layout of lighting plan was by Harold Moss of the Hy-Lite Corporation.

Keeping Pace With Evolution

It has been truly said, that due to the constant improvement in lighting equipment and the public's increasing consciousness of planned illumination, few lighting installations can be considered adequate for more than seven or eight years. In other words, lighting which was considered modern even as recently as 1940 is already classed as inadequate by today's standards. This is effectively illustrated by the three photographs taken in the offices of the Otis Elevator Company, Boston, Massachusetts in 1928, 1938 and 1948, representing that company's policy of keeping pace with the evolution of lighting acceptance.

Two decades ago, Guth Brascolites furnished the general illumination but, due to wide spacings between fixtures, illumination was uneven, ranging from a peak of 10 footcandles directly under

1928—Wide spacing of lighting fixtures and brightly lighted enclosing bowls created uneven lighting and glare. Eye fatique, clerical errors and reduced production were often noticeable under these conditions.

Your store customers recognize the need for uninterrupted lines of illumination over the merchandise areas of their stores. The new Slimline "Merchandiser" answers this need. It provides efficient general-area lighting combined with spotlights to attract attention to special counter and floor displays.

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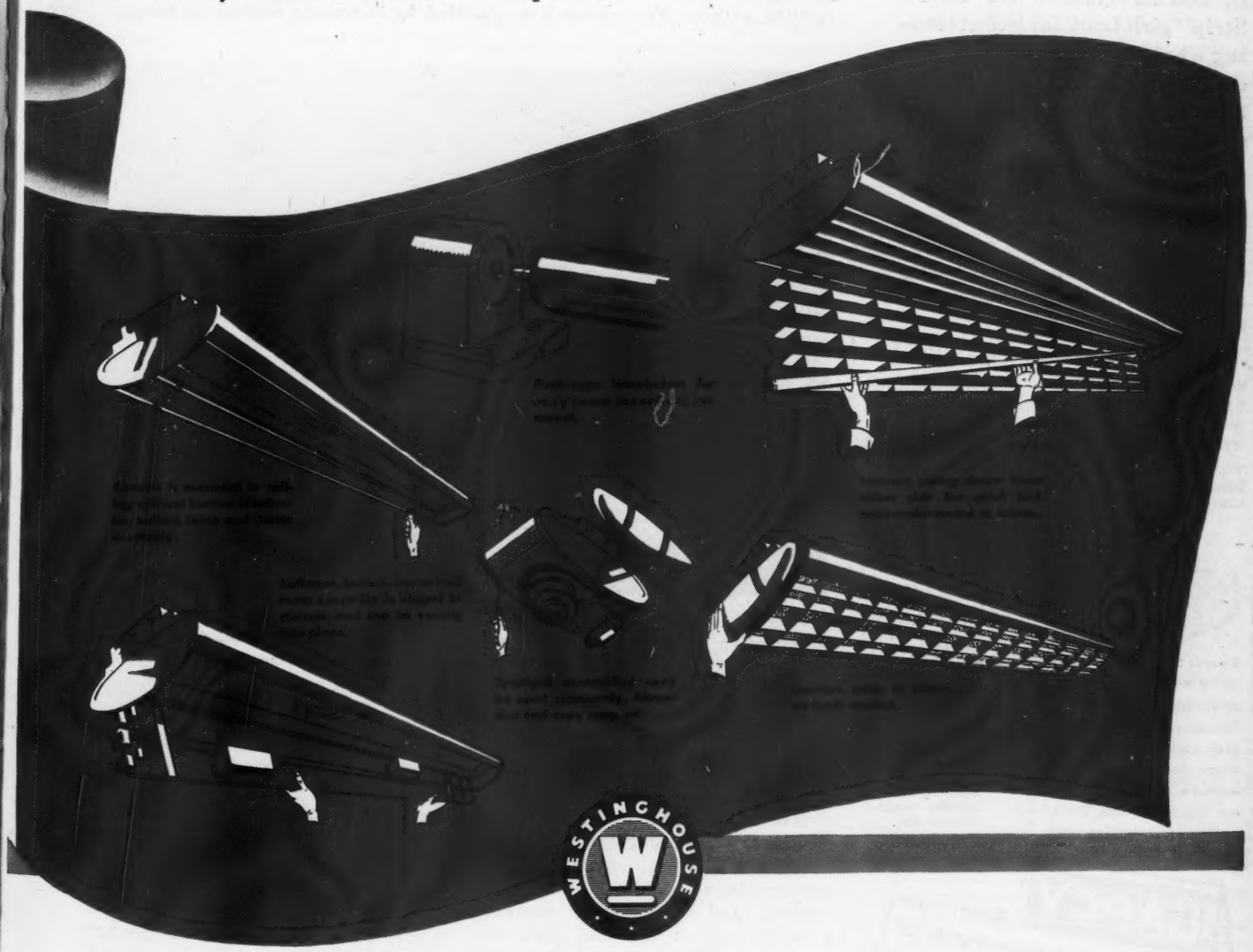
Westinghouse now offers you a complete line with the Slimline "Merchandiser" and its three companion units: CS-80, CS-160 and CS-170. They are all available now to help your customers improve store appearance ... have better lighting on the merchandise ... increase sales and profits.

Recommend the "Merchandisers" to your store customers. A Westinghouse Lighting Engineer is always available to offer technical assistance in planning store lighting. Call your Westinghouse Distributor today. Ask for the new booklet, B-4076, *"Smart Selling Begins with Planned Lighting"* or write Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. J-04198



Planned Lighting *Pays*

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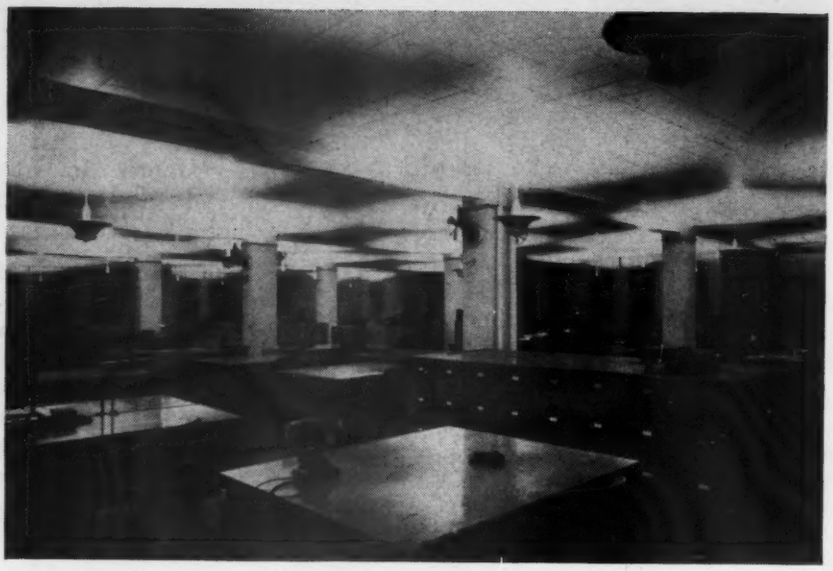
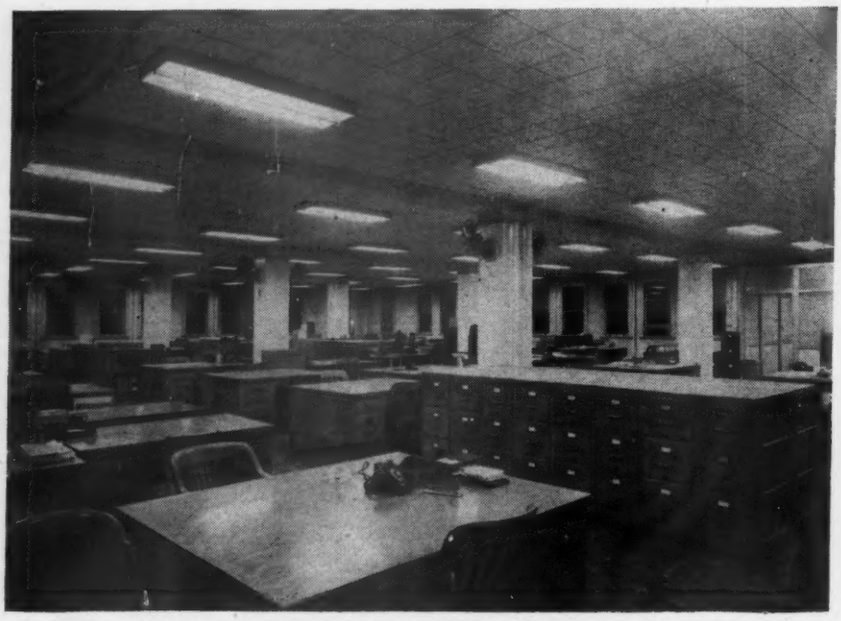


1938—General appearance of office was improved by installing acoustical ceiling, tiled floor and pendent-mounted indirect incandescent units from existing outlets. Footcandles were doubled by increasing wattage of lamps.



1948—By doubling number of fixtures, with four 40-watt fluorescent lamps shielded by louvres in each luminaire, dark spots were eliminated, lighting intensities were again increased and office assumed new spaciousness.

the fixtures to approximately 3 or 4 between lighting units.

By 1938, the office had been modernized by an acoustical ceiling, asphalt tiled floor and suspended indirect luminaries. By increasing the wattage of incandescent lamps, footcandles were approximately doubled. By suspending fixtures and illuminating working areas by indirect reflection, glare was eliminated and variations in intensity became less pronounced. But spacing of units remained the same due to wiring limitations and dark areas still existed.

The present lighting plan, submitted by the lighting department of the Boston Edison Company, utilizes Smithcraft fluorescent fixtures containing four 40-watt 48-inch lamps each. Although two fixtures have been connected to each former circuit, the changing from incandescent to fluorescent sources made it possible to utilize existing wiring without overloading circuits. Footcandles on working areas were again doubled, dark spots have been eliminated and the office area has a new appearance of spaciousness and cheer. Surface mounted and louvred, fixtures deliver uniform and high intensity illumination without excess glare.

Otis has found from experience that good lighting is good business. For office personnel become less fatigued, clerical errors have been reduced and output has been increased.

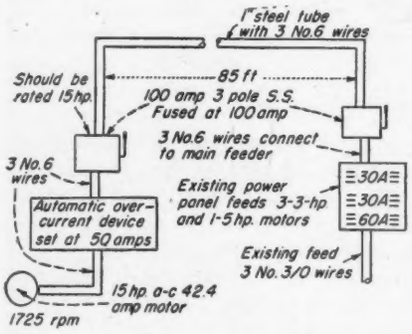
Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector, New York Board of Fire Underwriters, New York, N. Y.
Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

Questions on the Code

Motor Installation

Q. *We are planning an installation as shown in sketch below, but we have had a number of contractors doubt if it is a legal installation.*

We maintain the fact that we are wiring for a 15 hp. motor only, and said motor is protected with a 50 amp.



over-current device, this will protect the motor and therefore will protect the feeder from any over-current.

Also the Code states that a 15 hp. motor can be wired with No. 6 wire, but a 15 hp. motor will not start under a 55 amp. fuse and we therefore fuse the wire at 100 amp.—J.F.

A. A 15 hp. 3 phase 208 volt motor would have a rating of about 42.4 amps.

This would require over-current protection at not over 53 amps., so that the 50 amp. "over-current device set at 50 amps." would satisfy that requirement. This is evidently a circuit breaker or controller with thermal trip and is the controller required.

No. 6 wire which has a carrying capacity of 55 amps. would also satisfy the rule requiring a carrying capacity of 125 percent of the motor rating.

The "100 amp. 3 pole S.S." is the disconnect switch which is required ahead of the controller. This however, instead of having a rating of 100 amps., must be rated at 15 hp. or more. Fuses are not needed at this point.

The "100 amp. 3 pole S.S." over the panelboard, is a feeder switch and may be rated in amperes. Over-current protective devices are required at this point, as the No. 6 wires are tapped off of No. 3/0 wires and these devices can be rated at 125 amps., although they are protecting No. 6 wire.

If time lag fuses are used at this point, they could be rated at 50 or 60 amps., as such fuses are designed to take care of the motor starting current (inrush), but then to protect the motor while running at 125 percent of its rating as required by the Code.

If this latter suggestion is followed, no other fuses would be required in the motor branch circuit.—F.N.M.S.

Receptacles

Q. *Our inspector has insisted that all receptacles located on open or screened porches be only of the weatherproof type. Is this also required by the Code?—M.M.G.*

A. The Code under Section 4163 states that receptacles installed in damp or wet locations shall be of the weatherproof type. Therefore the inspector enforcing the Code must decide whether or not the receptacles are subject to rain or snow. Naturally there are many types of porches, and it is possible on the larger porches to visualize a location which could not be reached by rain or snow during normal conditions. However, it is always best to be sure, so unless your inspector agrees that the location is safe to use an ordinary outlet, use the weatherproof type.—G.R.

Generating Unit

Q. *A client of mine has purchased a 110 volt a-c lighting plant for use at his summer home and has asked me to install it and wire the building. Does the Code require the neutral to be grounded on such an installation?*—M.J.S.

A. Yes. The neutral must be grounded even though the generating unit serves only a single building. This will be found under Section 2526, which reads as follows: "For an interior wiring system or circuit which is required to be grounded and which is not connected to an exterior secondary distribution system, the grounding connection shall be made at the transformer generator, or other source of supply, or at the switchboard on the supply side of the first switch controlling the system!" Then under Section 2514 you will find that alternating current systems supplying interior wiring must be grounded providing the maximum voltage to ground does not exceed 150 volts.—G.R.

Motors

Q. *We have been asked to replace a motor driving a ground feed leg in a feed mill, and it seems to be impossible to obtain a Class 2 motor. The room in which this motor must operate is not only difficult to reach but is very dusty while the mill is operating. We can get a totally enclosed motor immediately, but it does not bear the approval of the Underwriters for use in a Class 2 location. Does the Code prohibit the use of such a motor now?—M.M.L.*

A. The Code requires that motors used in such locations be approved for the purpose. This will be found under Section 5058a, where the first sentence reads as follows: "In Class 2 Division 1 locations, motors, generators and other rotating electrical machinery shall be totally enclosed not ventilated, totally enclosed pipe ventilated, or totally enclosed fan-cooled, and shall be approved for Class 2 locations." Due to the inability of the manufacturers to supply approved Class 2 motors within a reasonable length of time, some inspection agencies have granted special approval for the use of any one of the three types

of motors referred to in Section 5058-a even though the motor does not bear the approval label of the Underwriters' Laboratories, providing the owner understands that such a motor must not be expected to operate under a blanket of dust. Some agencies have required that either an air line be run to the motor or that a portable blower be obtained.

Due to the fact that this is a temporary condition caused by the unusual demand for motors, it would be advisable, I believe, to discuss this problem with your inspector and the owner and attempt to reach an agreeable solution.—G.R.

Wires in Service Raceways

Q. *Wiring specifications very often specify that metered and unmetered wires may not be run in the same conduit. I cannot find this in the Code. Will you please let me know if this is required by the Code? We ran into a job done by others where they ran the main feeders through conduit to the meter, then on to the main switch. In order to feed an upper story they ran sub-feeders back through the same conduit to the outside of the building and then up to the second floor.*—G.T.B.

A. The above would be a direct violation of the Code. Section 2306 prohibits running conductors other than those concerned directly with supplying current to the building from being run in the service conduit with the service wires.—F.N.M.S.

Sealing Fitting in Conduit

Q. *We are wiring a truck terminal freight house and the inspector demands that we use a sealing fitting in each conduit run which enters or leaves the building wall. Lights over the loading platforms are served by the circuits lighting the aisles so there are a number of conduit runs extending through the outside wall. Does the Code say that a sealing fitting must be placed in each such conduit run at the wall?*—D.T.

A. Section 3015 of the N. E. Code states that where portions of interior raceway systems are exposed to widely different temperatures, provision must be made to prevent circulation of air from a warmer to a colder

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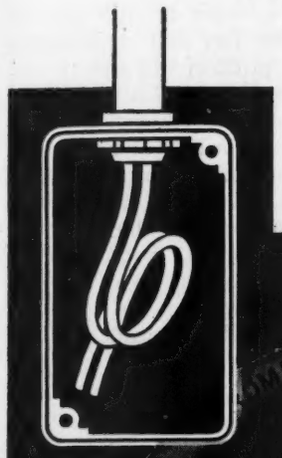

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section of the raceway. This section refers to cold storage plants and no mention is made of raceways common to both the inside and outside of a building. Therefore your question should be directed to the National Electrical Code Committee if you desire an Official Interpretation.

Inasmuch as there is little question concerning the fact that condensation is a serious problem in raceway systems, it seems only logical to prevent the formation of condensation whenever possible regardless of Code rules. Every conduit run passing through an outside wall will act as a miniature condenser unless the flow of air through it is blocked. Nothing in the Code would require the use of a special sealing fitting as the Code says that "provisions shall be made". That might be a sealing fitting or some ordinary oakum in a condulet or other fitting. If the air cannot flow from the warm to the cold area, condensation will not take place.—G.R.

Ensilage Unloader

Q. *I have installed a number of these new silo unloading units and now I am curious to know if I have violated the Code as the switch controlling and disconnecting the units is never within sight of the motor. This device rests on top of the ensilage within a silo. A motor through a gear train turns an arm which removes a thin layer of ensilage and directs it down the chute. As the appliance rests upon the ensilage, it must be connected by means of a long flexible cord. Will the Code require a disconnect or control switch within sight of the motor?* —F.G.

A. Most ensilage unloaders I understand have been equipped with a short Type S cord and a lock type attachment plug with a separate Type S cord and a suitable receptacle. The separate cord is long enough to reach one-third or one-half the height of the silo, making it necessary to install two or three outlets into which the separate cord can be plugged. Under Section 4402-d you will note that for portable motors an attachment plug and receptacle can be used as a disconnecting means and under Section 4386 you will find that the motor controller need not be within sight of the motor it controls when its disconnecting means can be locked in the open position. Therefore, an ensilage unloading machine that is provided with an attachment plug and receptacle which is always within reach of the device may be installed with the control switch at a point out of sight of the motor on the unloader.—G.R.

Circuit Wires

Q. *The National Electrical Code says you cannot reduce the wire size without refusing. In this case I would think it would be permissible. In residence house wiring for the lighting circuits, we use 15 ampere multibreakers. Then we use No. 12 wire for the circuit wires, but for the switch legs we use No. 14 wire. Is the reduction in wire size this way permissible?* —T.M.

A. Where the protective device of a branch circuit is rated at 15 amps., the circuit is considered a 15 amp. circuit.

On a 15 amp. branch circuit, the wires may be No. 14 or they may be No. 12 or larger.

There is no violation therefore, if No. 12 circuit wires are used with No. 14 wire for the switch legs.

If the protective devices were larger than 15 amperes, then No. 14 wire could not be used for the switch legs.—F.N.M.S.

Conductors

Q. *I'm installing lighting on an athletic field and wish to run No. 10 conductors through conduits from a distribution panel mounted on the base of 100 foot steel towers. It will be approximately 90 feet from the distribution panel to the lighting fixtures. Will it be necessary to support these conductors halfway up the towers? Also, will the Code permit the use of more than nine conductors in a conduit on such towers?*—T.S.

A. The National Electrical Code will not require conductor supports halfway up these towers. Under Section 3014, which provides for conductors in vertical raceways, you will find a table indicating the maximum vertical run permitted without supports. Conductors ranging in size from No. 18 to No. 0 shall be supported at intervals not greater than 100 feet.

The Code will limit the number of conductors which may be run in a single conduit to nine. However, by making use of the permission granted in Section 7312, each conduit run can carry eight circuits as Section 7312 gives permission to use a common neutral with as many as eight ungrounded conductors. Please note that when such a common neutral is used, it must have twice the carrying capacity of one of the ungrounded neutrals and that such practice is limited to a single pole or tower supporting lighting fixtures.—G.R.

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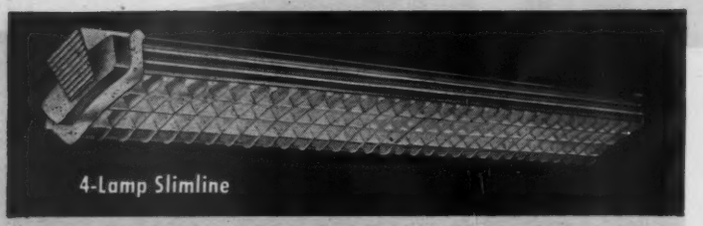

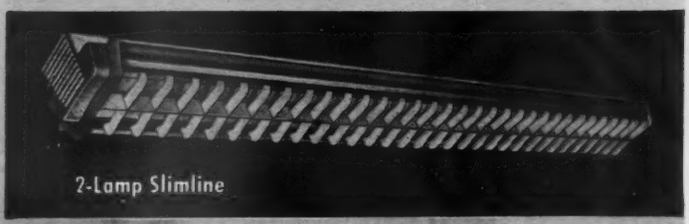

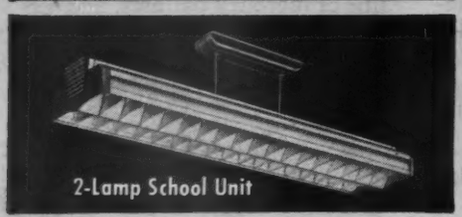

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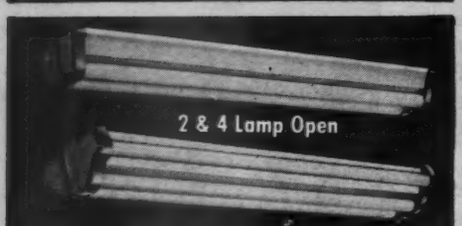

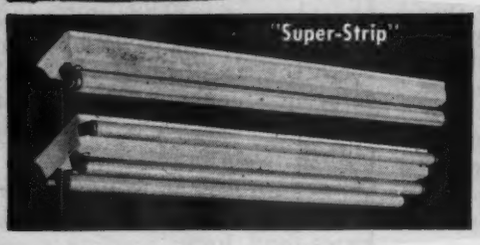

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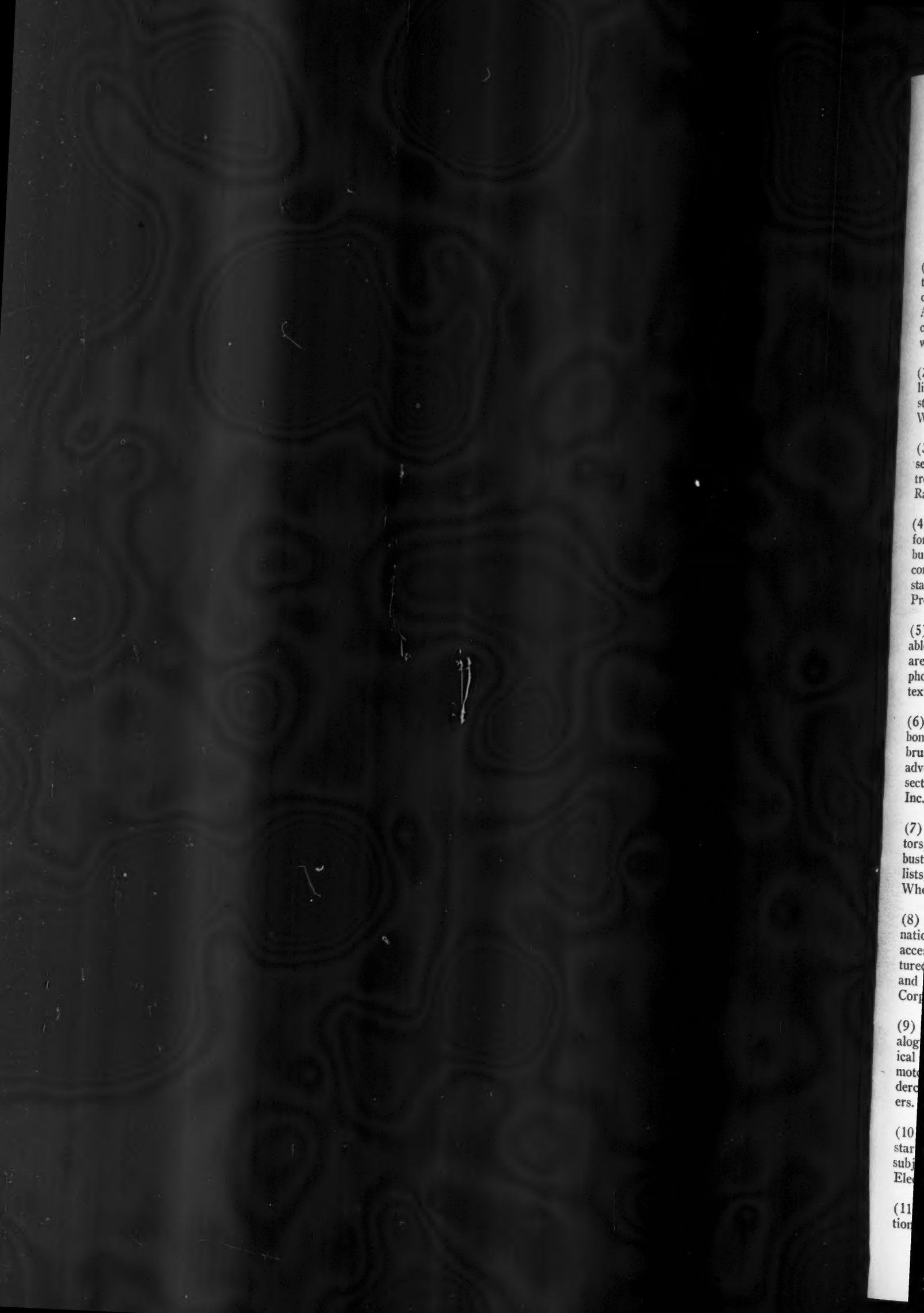

NEW LITERATURE

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(2) MAGNETIC STARTERS—Across-the-line-type non-reversing a-c magnetic starters are presented in bulletin 4110. Ward Leonard Electric Co.

(3) ELECTRONICS—Catalog 117 presents "everything in radio and electronics" in 180-page listing. Allied Radio Corporation.

(4) COMMERCIAL LIGHTING—Fixtures for office, factory, school and similar buildings are included in catalog with complete specifications, prices and installation accessories. Globe Lighting Products, Inc.

(5) PORTABLE GENERATORS — Carryable gasoline-engine-driven generators are discussed in bulletin L-408 with photographs, drawings and detailed text. Homelite Corp.

(6) BRUSHES—Standardization of carbon, graphite and metal-graphite brushes for motors and generators is advocated and explained in catalog section B-2106. National Carbon Co., Inc.

(7) ELECTRONIC CONTROLS — Indicators, controllers, recorders and combustion safeguards, together with price lists, are included in bulletin Z6500. Wheelco Instruments Co.

(8) HAMMERS AND DRILLS—Combination electric hammer and drill, with accessory devices are discussed, pictured and priced in catalog sheets 485 and 6 9-1-48. Wodack Electric Tool Corp.

(9) MAINTENANCE EQUIPMENT—Catalog 27 includes electrical and mechanical maintenance equipment, such as motor-flex units, sanders, millers, undercutters, reamers, testers and blowers. The Martindale Electric Co.

(10) A-C STARTERS — Combination starters with circuit breakers are the subject of bulletin 4130. Ward Leonard Electric Co.

(11) PLUGS AND RECEPTACLES—Section 7 includes data on series receptacles and plugs, unilets, extension cable connectors, housings, etc. Appleton Electric Co.

(12) RECTIFIERS—Mechanical rectifiers for low voltage power conversion is discussed in bulletin 4809, with historic background, development, explanation of principles and diagrams for operation. I-T-E Circuit Breaker Co.

(13) LIGHTING LAYOUT GUIDE—Plastic planned lighting layout guide with die-cut shapes for drawing fluorescent and incandescent fixtures and 8-inch ruler. Edwin F. Guth Co.

(14) TEST EQUIPMENT — Industrial testing equipment for electrical contractors, maintenance and repair men, including analyzers, appliance and insulation testers, is subject of bulletin 148. Triangle Instruments Co.

(15) VIBRATION CONTROL — Advantages and limitations of spring mountings, rubber and cork materials for controlling vibration, with installation data and application hints, are contained in bulletin G-101. Korfund Co.

(16) UNIT SUBSTATIONS — Planning and engineering guidebook for load

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(17) STORE LIGHTING—Planned lighting equipment for creating outstanding stores is subject of booklet detailing show window, wall case and accent lighting units. Edwin F. Guth Co.

(18) HANGERS AND SUPPORTS—Devices for supporting and suspending pipe, conduit and tubing are presented by sketches, dimensions, text and price list. The Kindorf Co.

(19) DRY TYPE TRANSFORMERS—Installation, care and operation of dry type transformers is covered in bulletin 61X7088; connection diagrams, installation photos, charts, and diagrams included. Allis-Chalmers Mfg. Co.

(20) SLIM LAMP FIXTURES—Folder describes slim lamp fixtures for 2 or 4 lamps, louvered or unshielded. Arc-Ray Electric Corp.

(21) INSULATING VARNISH—Three types of internal curing insulating varnish are discussed in folder giving attention to penetration, curing, bonding strength, solvents used, resistance and baking cycles. Irvington Varnish and Insulator Co.

(22) FIXTURE PRICES — List price schedule, effective July, 1948, covers open, lensed and louvred troffers as well as fixed and adjustable spot lights. Mobilite Inc.

(23) SEALED MOTOR—Totally-enclosed fan-cooled sealed motors are presented with specifications, drawings, cutaway photographs and operational data. Crocker Wheeler.

(24) RESIDENTIAL LIGHTING — Revised catalog includes lighting equipment designed to offer pattern control to the home-owner. Lightolier.

(25) GROUND RESISTANCE — Testing outfit designed to measure resistance of grounding medium is explained, using wiring diagrams, photographs and text in bulletin 160. Borden Engineering Co.

(26) SPOT LIGHTS—Recessed, surface-mounted and suspended spot lights, both fixed and adjustable, with variety of bases, louvres, color filters and finishes are presented in folder titled Hi-Hats and Hi-Lites. Litecraft Mfg. Co.

(27) MAGNET CHARGER—Adapters for production charging of industrial magnets are illustrated and described in 6-page 2-color folder. Radio Frequency Laboratories, Inc.

(28) SUBSTATION TRANSFORMERS — Construction details and performance features of substation transformers for rural and industrial service in ratings from 50 to 500-kva. are covered in bulletin 61B6014A. Allis-Chalmers Mfg. Co.

(29) CONTROLLED LIGHT—Fluorescent fixtures with light-controlling lenses are treated, together with installational details, distribution curves, dimensions, technical data, and accessory incandescent accent spot lighting units. Sunbeam Lighting Co.

(30) BATTERY CONNECTORS—Bulletin GB-648 discusses battery connectors for engine starting, battery replacement, single and multiple contents, general electrical application and oil field pumping use. Cannon Electric Development Co.

(31) RLM SPECIFICATIONS—The importance of the quality standards established by the RLM Standards Institute to insure efficient and economical lighting installations is stressed in booklet designed to educate those who purchase, specify or install industrial lighting equipment. RLM Standards Institute.

(32) THREADED BLIND RIVETS—Data book includes complete information concerning internally threaded blind rivets which may also serve as blind nut plates. Tools, methods of application and selection, dimensions and allowable stresses are included. B. F. Goodrich Co.

HOW TO ORDER—Two post cards are printed here. On each is room for you to request four pieces of literature. If you are requesting four pieces or less, please use only the bottom card. For five to eight pieces use both cards.

These cards not good after February 1, 1949

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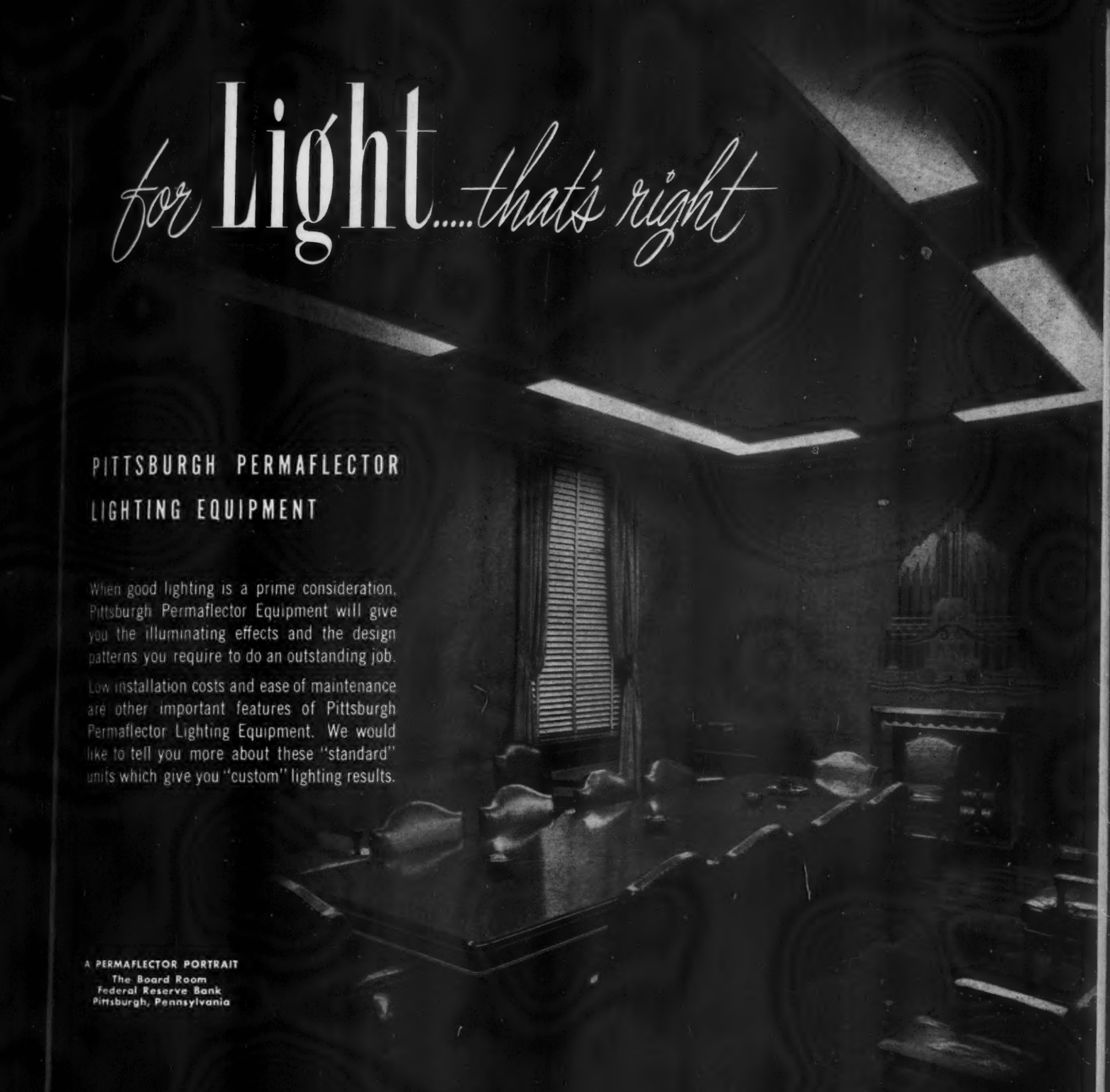
Your Title.....
Electrical Construction and Maintenance, N. Y. 12-48

for Light.....that's right



PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT

When good lighting is a prime consideration, Pittsburgh Permaflector Equipment will give you the illuminating effects and the design patterns you require to do an outstanding job.

Low installation costs and ease of maintenance are other important features of Pittsburgh Permaflector Lighting Equipment. We would like to tell you more about these "standard" units which give you "custom" lighting results.

A PERMAFLECTOR PORTRAIT
The Board Room
Federal Reserve Bank
Pittsburgh, Pennsylvania

Pittsburgh Permaflector Universal Troffers are formed into a rectangular pattern in conjunction with the air conditioning units. The troffers are equipped with hinged Alba-lite glass panel closures. Multiple switch control provides three levels of illumination.
Electrical Contractor: The Howard P. Foley Company.

"Pittsburgh" Permaflector

WANT THE FULL STORY ABOUT OUR LIGHTING EQUIPMENT?

Send for your copy of Catalog 48-F. It contains complete information, specifications and other data on the troffers used above and other Pittsburgh Permaflector Fluorescent Units and Companion Incandescent Equipment.

PITTSBURGH REFLECTOR COMPANY

OLIVER BUILDING · PITTSBURGH 22, PENNSYLVANIA

MANUFACTURERS OF FLUORESCENT & INCANDESCENT LIGHTING EQUIPMENT

Permaflector Lighting Engineers in all Principal Cities

PITTSBURGH PERMAFLECTOR LIGHTING EQUIPMENT IS DISTRIBUTED BY BETTER ELECTRICAL WHOLESALERS EVERYWHERE

PRIMARY LOOP SERVES PRINTING PLANT [FROM PAGE 53]

rupter disconnect switch which is key interlocked with the associated main secondary breaker. Each transformer has over-temperature alarm contacts for operation of a remote annunciator.

All power substations have dual transformers with 2000-ampere, 3-phase electrically operated, draw-out type main and tie secondary breakers. All lighting substations have dual transformers with 1000-ampere, 3-phase, draw-out type, manually-operated main and tie secondary breakers. All tie and main secondary breakers are equipped with 125 volt d-c shunt trip coils. In the main secondary breaker positions, the automatic tripping of the breakers is controlled by three over-current directional relays which prevent energizing of the transformers from the secondary side and prevent reverse power feed into a primary cable or transformer vault. Automatic tripping of any tie or main secondary breaker is indicated on an annunciator in the electrical maintenance shop.

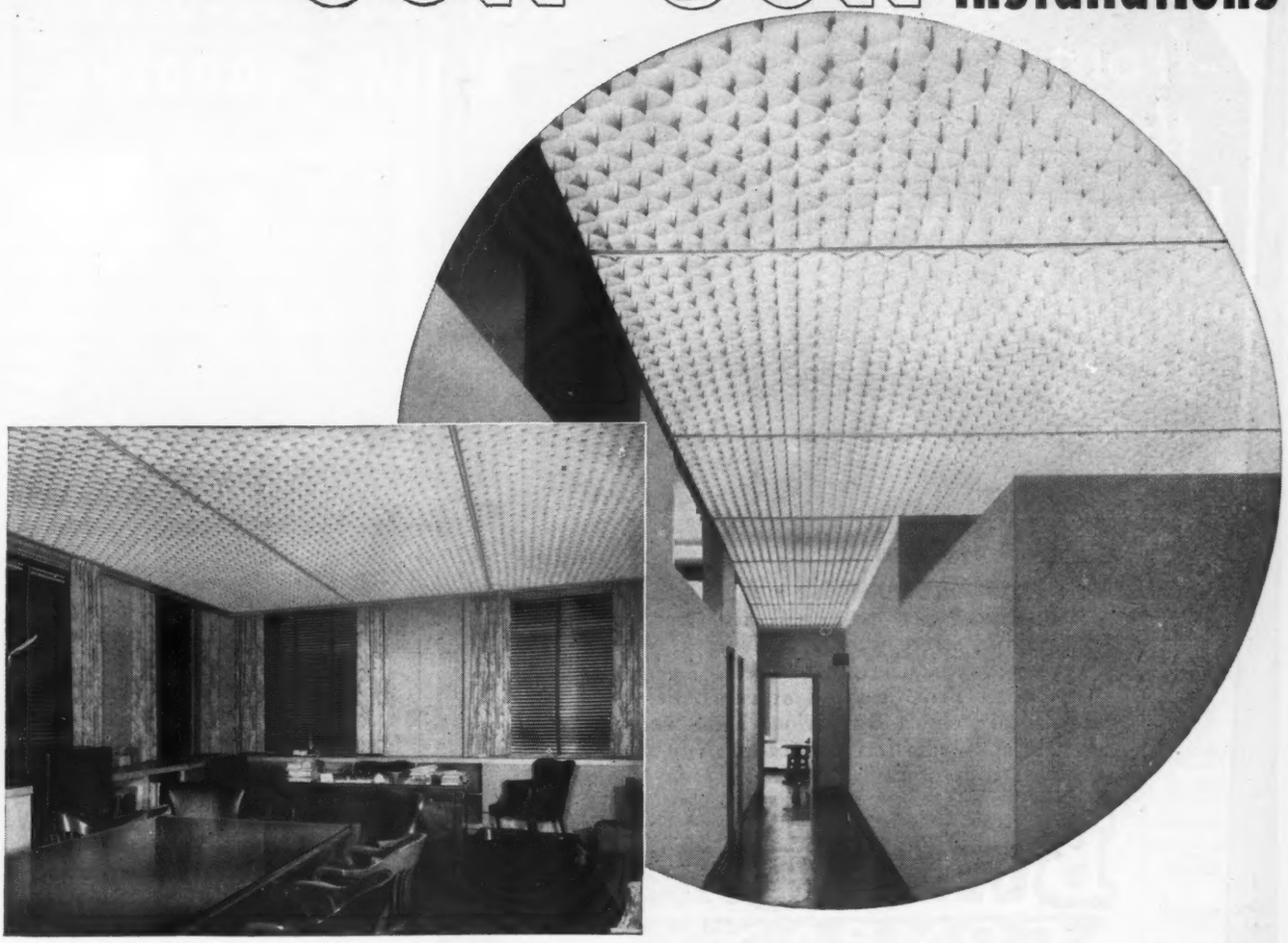
Parallel Operation

Under normal operation the tie breakers will be kept closed to provide a dual transformer feed to all power and light services. Parallel operation of the transformers provides good voltage regulation for the heavy load swings which occur when large press drives are started. The Primary and Secondary radial distribution systems provide continuity of service at all times. Power and light feeder breakers have an interrupting capacity of 50,000 and 25,000 r.m.s. amperes. The main secondary breakers are properly coordinated with the "cascaded" feeder breakers to permit parallel operation of the transformers. All feeder breakers are draw-out type and those of like rating are interchangeable.

Metering current transformers are installed on the secondary side of all power and light transformers. A single-phase ammeter with 3-phase ammeter transfer switch and polyphase watthour meter provide an indication of instantaneous load and a record of the total kw. delivered. All substations are equipped with single-phase voltmeters and 3-phase voltmeter transfer switches. Power feeders are equipped with single phase ammeters; lighting feeders with single-phase ammeters and 3-phase ammeter transfer switches.

Lighting sales *GOING UP* with

FEDERAL Cell-Ceil* Installations



Foyers, display rooms and offices are taking on new life and glowing beauty with the application of Federal Cell-Ceil, the most modern lighting treatment. And, these installations are pushing lighting sales higher every day.

This beautiful overall ceiling louvering is easy to install. The light-weight sturdy hanging mechanism developed for Cell-Ceil not only speeds up application but provides such easy access for relamping and cleaning that continued customer satisfaction is assured.

Your customers are being told about Federal Cell-Ceil through full page advertisments every month in Architectural Forum, Architectural Record, Progressive Architecture and Interiors.

Increase your lighting sales—be ready to deliver Federal Cell-Ceil now! The Federal engineering staff will gladly advise on any installation problem. Our technical bulletin on installation techniques is also available, address Dept. CC-2.

*Trade Mark "Cell-Ceil" applied for.

FEDERAL ENTERPRISES, INC.

Formerly: FEDERAL ELECTRIC COMPANY, INC.

8700 S. STATE STREET • CHICAGO 19, ILLINOIS

All unit substations for power and light provide for future installation of additional cubicles. The transformers, main, tie and feeder breakers are along opposite sides of a common operating aisle with an overhead enclosed tie bus. Future breaker cubicles can be added to one end of each structure. In the conventional arrangement for double-ended unit substations the secondary switchgear is "sandwiched" between transformers located at each end. While requiring less copper for the secondary bus tie, this method requires present installation of empty cubicles for future needs that may never be used.

Power Feeders

All building utility and process equipment motors are connected for 220-volt, 3-phase, 60 cycle service. The time and economic considerations involved in moving presses, motors and controls from the present building and replacing present 220-volt motors and controls precluded use of a 440-volt system.

Feeds from substations to power panels consist of 500 to 750 MCM, single-conductor, 600-volt cables installed in conduits. The 800 and 1200-ampere feeders consist of two and three 500 MCM, single-conductor cables per phase, installed in parallel conduits.

All power panels are of the latest safety, dead-front type, with quick make-and-break type "A" switch and fuse branches designed for heavy duty service. Individual interlocked doors are provided over each circuit compartment, with provisions for padlocking in either the "OFF" or "ON" position.

Lighting Feeders

Lighting feeders and panels are designed for 208/120-volt, 3-phase, 4-wire service. In general, each lighting feeder serves two or more panels. Panels in the same location on the first and second floors are fed by the same feeder.

All lighting panels are surface mounted, single-row type. Wireway extensions from the floor to a pull box just below the ceiling, provides ample space for all existing and future circuit wiring. Branch circuits are protected by individual, automatic circuit breakers. Lighting and receptacle circuits have minimum No. 12 conductors in $\frac{3}{4}$-inch minimum size concealed conduits. Light sources and luminaires were selected in accordance with mounting heights, spacing, utilization of space and intensities desired.

WHICH G-E INSULATING VARNISH FOR YOUR JOB?

WHY G-E INSULATING VARNISH 1673 WAS SELECTED FOR THIS OUTDOOR SWITCHGEAR

Outdoor switchgear must weather harsh exposure to sun, storm, and dirt. So General Electric specialists recommended G-E Insulating Varnish 1673 for this really rugged service.

Clear-baking G-E Varnish 1673 has excellent penetration and aging qualities. It dries hard and resists almost everything—oil, heat, moisture, acids, alkalis, and arcs. And it provides amazing flexibility during assembly and in service.

Your insulating problem gets prompt, personal attention at General Electric. Depend on G-E experts to prescribe the proper varnish to do your job best. And count on G-E quality control methods to keep every shipment uniform.

Get more information from your local General Electric Merchandise Distributor. Or write: Resin and Insulation Materials Division, Chemical Department, General Electric Company, Schenectady 5, N. Y.

Here Are a Few of the Many G-E Varnishes Designed for Specific Types of Applications

	FOR REPAIR WORK	FOR MARINE EQUIPMENT	FOR TRANSPORTATION EQUIPMENT	FOR INDUSTRIAL MOTORS
	G-E 9574	G-E 9435	G-E 1606	G-E 1678
BOND	EXCELLENT	GOOD	GOOD	EXCELLENT
DIELECTRIC STRENGTH	GOOD	GOOD	GOOD	EXCELLENT
RESISTANCE TO MOISTURE	EXCELLENT	GOOD	GOOD	EXCELLENT
RESISTANCE TO ALKALI	EXCELLENT	GOOD	FAIR	EXCELLENT
RESISTANCE TO ACIDS	EXCELLENT	GOOD	GOOD	EXCELLENT
RESISTANCE TO SALT WATER	EXCELLENT	EXCELLENT	GOOD	EXCELLENT
PENETRATION	GOOD	GOOD	EXCELLENT	GOOD
TOUGHNESS	EXCELLENT	FAIR	GOOD	EXCELLENT
HIGH TEMPERATURE AGING	EXCELLENT	GOOD	EXCELLENT	GOOD
FLEXIBILITY	EXCELLENT	GOOD	GOOD	FAIR

Order . . .

GENERAL ELECTRIC

CD48-88

Electrical equipment is no better than its insulation

DYNAMIC BALANCE

[FROM PAGE 61]

balance to guarantee the absence of couple action." Although this process was both tedious and costly at the beginning of the war, development of industrial balancing equipment has been rapid in recent years and is now in wide use, both in manufacturing and repair.

Balancing machines cover a wide field; beginning with low speed models recommended for balancing small bodies such as optical or radio equipment, and ranging up to units with unlimited capacities. The use of the machines is simple, rapid and economical. Machines can be adapted readily to established production lines. They require little space. They are ruggedly constructed for long service. Of particular interest to the electrical trades is the fact that true balancing is now economically possible for armatures, fans, blowers, flywheels, hubs, gears, pulleys, shafts and other similar rotating bodies.

Ideal for production and maintenance applications in motor repair shops are floor models which handle bodies weighing between 50 and 2000 pounds, with shafts ranging from 1 to 5 inches in diameter. Having cast beds and supporting towers resting on concrete base pads, they afford the rigidity and sturdiness necessary for all types of balancing. Simple adjustments enable the operator to change the machine set-up in a few minutes so that parts of various lengths and diameters can be readily accommodated.

In operation, the body to be tested is rotated at sufficient speed so that centrifugal forces due to an unbalanced distribution of weight along the axis of rotation can be measured and located. Without reversing ends of the body being balanced, the machines reveal whether a static or dynamic unbalance, or both, are present. Mechanisms built into the testing machines rapidly locate the disturbing force couple with a high degree of accuracy, simultaneously indicating on dials, screens, or gauges, the angular position and the amount of unbalance. It is then relatively simple to make corrections at the indicated positions along the axis of rotation to bring the body to a perfect state of static and dynamic balance.

With public acceptance and with repair work speeded and improved, the practice of dynamically balancing motors may soon become standard practice in many of our top-flight motor repair shops.

In the News

R. Stafford Edwards Receives McGraw Award

R. Stafford Edwards, president of Edwards & Company, Inc., received the James H. McGraw Award Manufacturers Medal for 1948. Presentation was made by W. T. Stuart, editor of *Electrical Construction and Maintenance* and secretary of the Committee of Awards, at a luncheon held in Atlantic City on November 10, during the convention of the National Electrical Manufacturers Association.

The citation, accompanying the award, read as follows:

"Combatting the secondary boycott was a task calling for great personal courage and uncompromising principle. For a business leader to participate in this endeavor was to invite great risk and often serious retaliation. For the past three years R. Stafford Edwards, president of Edwards and Company Inc. has worked unsparingly to arouse leaders in industry and government to the sinister consequences of the unrestrained secondary boycott, and through able research and compelling testimony has provided much of the foundation upon which anti-secondary boycott legislation is built today.

"In 1945 as Chairman of a Special Committee of NEMA, he undertook a survey to obtain specific examples of the use of secondary boycotts in the electrical industry. In spite of grave difficulties the project was completed largely through his personal efforts.

"During this time he created and maintained a strong interest throughout the electrical manufacturing industry in the secondary boycott problem and its possible solutions. The results of his survey together with documentary evidence of the widespread use of secondary boycotts were made available to legislators and administration officials. His willing and forceful testimony disclosed the destructive effects of secondary boycotts on the public welfare. His active personal efforts were instrumental in enlisting support from other industries.

"His untiring efforts and unflagging interest are widely recognized as a major influence in the eventual enactment of legislation to deal effectively with the more serious aspects of the problem.

"For his extraordinary efforts on behalf of his industry and the public welfare, the Committee of Awards, on the recommendation of the judges, has voted to Mr. Edwards the 1948 medal and purse given under the James H. McGraw Award."

The panel of judges who recommended Mr. Edwards for this honor consisted of George C. Thomas, Jr., The Thomas and Betts Company, Inc.; D. F. G. Eliot, Western Electric Company; J. K. Johnston, National Vulcanized Fiber Company; E .W. Seeger, Cutler-Hammer, Inc. and W. T. Stuart, the Committee of Awards.

Illinois Contractors Meet in Peoria

The first annual meeting of the Illinois Electrical Contractors, sponsored by the Illinois Chapter, NECA, was held in Peoria October 23. Approximately 180 contractors and guests from throughout the state took advantage of this opportunity to renew old acquaintances, make new friends and discuss, in session or in private, mutual industry problems.

Those present were given a comprehensive picture of what coordinated activities of the entire electrical industry can mean to the electrical contractor. As to the future of the electrical construction trade, Mark F. Slusser, manager, construction industry section, Westinghouse Electric Corp., presented a rosy picture. Use of electric power provides a good gage of the electrical construction market and the expected total production of 500 billion kilowatt hours by 1957 gives a fair indication of what lies ahead for the contractor, Slusser stated, while giving the breakdown by various industries. Total new construction may reach a peak of 25 million dollars per year before the cycle begins a downward trend, he revealed. Most fertile fields at present are the textile industry, as yet considered not progressive insofar as electrification is concerned; the food processing field, largest user of electric motors; the petroleum and chemical field where the present trend is from batch to continuous processing; and the maintenance and repair field which approaches one-half of the total new construction in dollar volume.

There are obstacles, however, Slusser warned. Most serious is the apparent complacency in our business. He advocated continuing vigorous apprentice training and adequate educational programs; development of aggressive sales forces; and keeping abreast of new developments and improvements in equipment and installation techniques. In view of increased use of electricity, conservative design considerations should include up to 100 percent additional capacity for future use, he added.

On the plus side of the business picture, Slusser listed maintenance, modernization and new fields for future expansion. With his know-how, installation and maintenance contracts, the electrical contractor is in the best position to coordinate the efforts of all phases of the electrical industry by selling a complete package, Slusser concluded.

Power supply trends in the State of Illinois were outlined by L. C. Auby, division operating engineer, Illinois Power Company. Using a portion of the state-wide utility system as illustration, he revealed an increase in demand of 88 percent in the past eight years; predicted another 28 percent growth in the next seven years. Total increase in plant capacity, proposed or installed since 1945, is 1,330,000 kilowatts which represents a 38 percent increase over capacity available at the end of 1947. It will be several years before adequate reserve capacity is available, Auby believes. Scheduled construction will enable the industry in Illinois to keep abreast of present and future power requirements, he concluded.

That the electrical distributor is the vital distribution link between manufacturer and contractor was clearly portrayed by W. E. Guy, Chicago district sales manager, Graybar Electric Company, Inc. Acting as mass dis-

tributors, they provide area warehousing, territory sales forces and personal contacts for manufacturers of thousands of items used in the electrical construction trade. With industry geared to high production, distributors must organize aggressive sales forces now, he warned. Touching on the supply situation, Guy revealed that copper demand is still 10,000 pounds per month above production; conduit fittings will show no improvement unless demand tapers off; wiring device deliveries will improve shortly.

The importance of the electrical inspector in this overall picture cannot be underestimated since he must see that approved materials are installed in accordance with safety standards. His is a specialty profession with life and property dependent upon his decisions. In view of this, electrical inspector activities should not be influenced by either politics, bureaus or other building departments, warned D. J. Talbot, chief electrical inspector of the City of Chicago. He urged municipalities to carefully consider this fact when enacting ordinances establishing electrical inspection departments; asked continued contractor cooperation in maintaining high wiring standards.

Benefits of association membership both to contractor and the public were recounted by P. J. Lowry, field director, National Electrical Contractors Association. Among the services NECA offers the contractor, Lowry listed: public relations and sales promotion; the Guarantee Certificate program; technical research; surplus material exchange—a spot service combined with the News Letter; and the NECA manual of labor units.

An open forum following the formal program permitted the contractors to discuss individual problems affecting their specific operations. Heading the list were such subjects as overtime-on-overtime pay; profit margins on electric motor sales; cooperation of material suppliers. By means of resolutions, the convention commended material suppliers for promoting the sale of their products through the electrical contractor and for their efforts in advocating the use of an electrical contractor on all jobs; asked the motor and control manufacturers for a better break in the sale of their equipment.

At the convention banquet, Thomas J. Murray, assistant business agent, Local No. 134, IBEW, Chicago, presented labor's views on the National Electrical Benefit Fund. He outlined the history of its development, administration, application, employee benefits.

E. B. Oberlander is president and Jack G. Krider, secretary-manager of the Illinois Chapter, NECA, the conference sponsor. Lyle Foster, Peoria contractor, was convention chairman.

ALABAMA

BIRMINGHAM . . . .
Electric Motor Service
606 S. 32nd St.

MOBILE . . . .
Russell Electric Co., Inc.
16 Dauphin St.

ARIZONA

PHOENIX . . . .
Electric Rewinding Co.

TUCSON . . . .
Pima Electric Co.

ARKANSAS

LITTLE ROCK . . . .
Fagan Electric Co., Inc.
Spring St. at 9th.

CALIFORNIA

LOS ANGELES . . . .
Motor & Machinists Supply Co.
230-236 S. San Pedro

OAKLAND . . .
Scott-Buttner Electric Co.
896—22nd St.

SAN BERNARDINO . . . .
Hunt & Van Slyke
572 Court St.

SAN DIEGO . . . .
California Electric Works
424 Eighth Ave.

SAN FRANCISCO . . . .
McKee & Strub
368 Ninth St.

SAN JOSE . . . .
San Jose Armature & Motor Works
673 S. First St.

COLORADO

DENVER . . . .
Weaver Electric Co.
1721 Larimer St.

CONNECTICUT

HARTFORD . . . .
Superior Electric Motor Co.
54 Elm St.

DISTRICT OF COLUMBIA

WASHINGTON . . . .
Warfield & Sanford, Inc.
913 "E" St., N. W.

FLORIDA

MIAMI . . . .
Electrical Equipment Co.
42 N. W. 4th St.

ORLANDO . . . .
Orlando Armature Works, Inc.
611-617 W. Central Ave.

TAMPA . . . .
Tampa Armature Works, Inc.
401 S. Morgan St.

GEORGIA

ATLANTA . . . .
Cleveland Electric Co.
557 Marietta St.

IDAHO

IDAHO FALLS . . . .
Rossiter Electric Co.

ILLINOIS

CHICAGO . . . .
Excell Electric Service, Inc.
2113 S. Western Ave.

ROCKFORD . . . .
Rockford Power Machinery Div.
Mid-States Industrial Corp.
2401—11th St.

SPRINGFIELD . . . .
Electric Service Co.
311 E. Monroe St.

INDIANA

FORT WAYNE . . . .
Wayne Electric Co.

INDIANAPOLIS . . . .
Frakes Electric Co.
252 Hudson St.

SOUTH BEND . . . .
Koontz Wagner Electric Co.
516 N. Michigan St.

IOWA

CEDAR RAPIDS . . . .
Electric Motors Co.
353 2nd St., S. W.

DES MOINES . . . .
Moore Electric Co.
1317 Walnut St.

SPENCER . . . .
Pixler Electric Co.
112 E. 8th St.

KENTUCKY

LOUISVILLE . . . .
Wm. C. Krauth Electric Co.
118 S. First St.

LOUISIANA

ALEXANDRIA . . . .
Bruno Electric Co.
1035 Lee St.

NEW ORLEANS . . . .
Reliance Electrical Works
814 Carondelet St.

SHREVEPORT . . . .
Shreveport Armature & Electric
800 Spring St.

MARYLAND

BALTIMORE . . . .
Lange Electric Co.
202-208 W. Chase St.

MASSACHUSETTS

BOSTON . . . .
Northeastern Electric Co.
250 Broadway

PITTSFIELD . . . .
Electric Supply & Repair Co.
63 Eagle St.

SPRINGFIELD . . . .
Superior Electric Service Co.
1113 Columbus Ave.

MICHIGAN

BENTON HARBOR . . . .
Electric Maintenance Co.
156—6th St.

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Deckert-Werner Electric Co.
998 W. Kirby

GRAND RAPIDS . . . .
Purchase Electric Co.
338 Bridge St., N. W.

SAGINAW . . . .
Killmer Electric Co.
610 North 16th St.

MINNESOTA

MINNEAPOLIS . . . .
Boustead Electric & Mfg. Co.
109 Washington Ave.

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Mielke Electric Works, Inc.
922 E. Superior St.

MISSISSIPPI

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Power Electric Co.
1920 N. Mill St.

LAUREL . . . .
Southland Pumps, Inc.
444 Front St.

VICKSBURG . . . .
Ludke Electric Co., Inc.
South & Mulberry Sts.

MISSOURI

KANSAS CITY . . . .
Barr-Thorp Electric Co.
2630 Holmes St.

ST. LOUIS . . . .
Zeller Electric Co.
4039 Gravois St.

MONTANA

BILLINGS . . . .
Lockrem Electric Co.
113 N. 25th St.

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BEATRICE . . . .
Sprague Electric Service
304 Court St.

OMAHA . . . .
Schneider Electric Works
1108 Farnam St.

NEW JERSEY

NEWARK . . . .
U. S. Electric Service Co.
263 Halsey St.

TRENTON . . . .
Lockwood Electric Motor
2239 Nottingham Way

NEW MEXICO

ALBUQUERQUE . . . .
Electric Motor Co.
510 E. Central

NEW YORK

ALBANY . . . .
Commodore Electric Co.
43-45 Liberty St.

BINGHAMTON . . . .
Walter J. Rider
324 Water St.

BUFFALO . . . .
Dynamo & Motor Exchange
41-45 Elm St.

HOLLIS, LONG ISLAND . . . .
General Electric Specialty
184-01 Hillside Ave.

LIBERTY . . . .
Dick's Battery & Automotive
Electric Service, 397 Main St.

MIDDLETOWN . . . .
Middletown Electric Motor Service
224 North St.

MOUNT VERNON . . . .
H. A. Schreck, Inc.
47 S. 3rd Ave.

NEW YORK CITY . . . .
Reading Electric Co.
102 Park Row

POUGHKEEPSIE . . . .
H. A. Schreck, Inc.
507 Main St.

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T. H. Green Electric Co.
31-37 N. Water St.

SYRACUSE . . . .
Roger & Hilton, Inc.
318-324 Pearl St.

NORTH CAROLINA

CHARLOTTE . . . .
Southern Electric Service Co.
714 W. Trade St.

GREENSBORO . . . .
Southern Electric Service Co.
853 S. Elm St.

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Electric Motor Repair Co., Inc.
418 S. Dawson St.

OHIO

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Matlock Electric Co.
1456 Harrison

CLEVELAND . . . .
B & P Electric Motor Repair
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TOLEDO . . . .
Fred W. Kiemle Co.
33-37 Superior St.

OKLAHOMA

OKLAHOMA CITY . . . .
Apex Electric Co.
620-626 N. Hudson St.

OREGON

MEDFORD . . . .
Gage Electric Motor Service

PORTLAND . . . .
L. A. Walker Electric Co.
206 N. W. 10th Ave.

PENNSYLVANIA

EASTON . . . .
Stokes Engineering Co.
48 S. Green St.

PHILADELPHIA . . . .
Mueller Electric Co.
216 N. 11th St.

PITTSBURGH . . . .
Myers Electric Co.
209 First Ave.

READING . . . .
Electric Motors Specialty
1831 Perkiomen Ave.

STEELTON . . . .
Electric Service & Machine Co.
760 N. Front

YORK . . . .
Industrial Electric Co.
116 E. Gas Alley

RHODE ISLAND

PROVIDENCE . . . .
Schmidt Electric Co.
137 Chestnut St.

SOUTH CAROLINA

CHARLESTON . . . .
Electric Motor Service Co.
156-B Meeting St.

FLORENCE . . . .
Florence Electric & Rewinding
115 S. Church St.

GREENVILLE . . . .
Southern Electric Service
119 Markley St.

SPARTANSBURG . . . .
Southern Electric Service
170 Ezell St.

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CHATTANOOGA . . . .
Chattanooga Armature Works
1215 Duncan Ave.

KNOXVILLE . . . .
Tennessee Electric Motor
919-21 North Central

MEMPHIS . . . .
Camp Electric Co.
1707 Madison

NASHVILLE . . . .
Tennessee Electric Motor
408-10 Commerce St.

TEXAS

AMARILLO . . . .
G. E. Jones Electric Co.
208 N. Polk St.

CORPUS CHRISTI . . . .
Corpus Christi Armature Works
423—14th St.

DALLAS . . . .
Riley Electric Co.
1608-10 Ewing
Pearsol Appliance Co.
2010 Commerce St.

EL PASO . . . .
Wayne M. Tinkler & Co., Ltd.
817 Cedar St.

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Central Electric Co.
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HOUSTON . . . .
Hill Electric Co.
1505 Austin St.

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Phillips Electric Co.
812 Houston St.

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Loyd Electric Co.
511 El Paso St.

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Sweetwater Electric Co.
108 Elm St.

WACO . . . .
Caldwell Electric Co.
1728 Franklin

UTAH

SALT LAKE CITY . . . .
Schraga Electric Co.
274 S. First, West

VIRGINIA

NORFOLK . . . .
Caddell Electric Co.
245 Court St.

RICHMOND . . . .
Electric Motor & Repair Co.
311 E. Carey St.
Richmond Battery & Ignition Corp.
1319 W. Broad St.

ROANOKE . . . .
Lloyd Electric Co.
334 W. Salem Ave.

WASHINGTON

SEATTLE . . . .
Fellstrom Electric Co.
2211—9th Ave.

SPOKANE . . . .
Nixon-Kimmel Co.
167 S. Wall St.

WISCONSIN

MILWAUKEE . . . .
Koenig Electric Co.
1119 N. 4th St.

Mass Quit Ruling

The mass quitting of work is "persuasive evidence" of a strike if there is no contrary explanation of the occurrence.

Such interpretation of the Taft-Hartley definition of a strike is given by a National Labor Relations Board trial examiner in the first ruling on this point to come from NLRB.

The case involves Roane-Anderson Co., which maintains and operates the electrical distribution system for the Oak Ridge townside and atomic reservation under contract with the Atomic Energy Commission. All but one of the 155 maintenance electricians and utility linemen employed by Roane-Anderson left their jobs on July 29 and 30 after the Kiser Electric Co. of Knoxville, a non-union subcontractor, began installing fluorescent fixtures in a school building.

Most of them remained away until September 2 when Federal Judge George C. Taylor, at the request of NLRB General Counsel Robert N. Denham, issued an injunction forbidding the IBEW to continue a strike seeking to force a secondary boycott against Kiser Electric Co. The injunction is effective until NLRB decides whether the union is guilty of a secondary boycott—an unfair labor practice.

The examiner, Arthur Leff, rejected the assertions of 13 employees who testified that they quit as a result of individual decisions. The union pointed to Section 502 of the Taft-Hartley law, which states that nothing in the law shall "be construed to make the quitting of his labor by an individual employee an illegal act."

Leff said that, although most of the men quit after they had reported for work or in mid-shift, they were unable to point to any specific incident arising at that time which prompted them to decide individually to quit.

Although the IBEW, which holds a contract with Roane-Anderson, did not formally call a strike or conduct a strike vote, Leff said its responsibility for the stoppage was proved by evidence of ten instances of inducement, direction and encouragement by union officials who were acting as agents of the union.

It was mandatory under the Taft-Hartley law for Denham to seek the injunction, without delay, after he found grounds for Roane-Anderson's charges of secondary boycott against the IBEW. The law requires such action in secondary boycotts. This feature of the law has particularly been criticized as unfair by union leaders because it does not provide for any mandatory injunctions against management.

Thread Small Pipe

in almost "Nothing Flat"

RIDGID Ratchet Threaders Nos. 00R, 111R and 12R make short work of threading 1/8" to 2" pipe

● No fuss or bother getting ready—just snap in size die head you need and these smart little RIDGIDs are ready to go to work. You don't need special dies for close-to-wall threads. Heat-treated tool-steel dies give you fast clean accurate threads. These efficient durable RIDGID threaders are favorites with pipe tool users everywhere. Buy them at your Supply House.

. . . Handy free carrier for any group of sizes.

Clean Accurate Pipe Cuts at Top Speed

RIDGID efficiency-balanced cutter saves your muscle . . . gives you more pipe cuts for your money . . .

● The efficiency-balanced RIDGID Cutter is a natural for extra fast pipe or conduit cutting. Thin blade tool-steel cutter wheel always tracks perfectly—leaves practically no burr. Every cutter factory-tested to make sure of it. Your choice of 5 sizes to 6" pipe; 4-wheel cutters to 4," designed for easier work in tight places. Save your time and muscle—buy RIDGID Cutters at your Supply House.

RIDGID
4-wheel cutter for fast cuts in tight places.

RIDGID WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

Dates Ahead

National Electrical Contractors Association — 47th Annual Meeting, Roney Plaza Hotel, Miami, Fla., November 30-December 3.

Electrical & Gas Association of New York, Inc.—Luncheon meeting, Grand Ballroom, Hotel Astor, New York, N. Y., December 22.

Independent Electrical Contractors Association, Inc.—43rd Annual dinner, Hotel Astor, New York, N. Y., January 15, 1949.

American Institute of Electrical Engineers—Winter general meeting, Pennsylvania Hotel, New York, N. Y., January 31-February 4, 1949.

Electrical League of Milwaukee—Annual industry dinner dance, Hotel Schroeder, February 12.

National Electrical Manufacturers Association—Winter convention, Edgewater Beach Hotel, Chicago, Ill., March 13-18, 1949.

Third International Lighting Exposition and Conference—Hotel Stevens, Chicago, Ill., Week of March 28, 1949.

National Electrical Wholesalers Association—41st Annual Convention, Netherland Plaza Hotel, Cincinnati, Ohio, May 1-6.

Chamber of Commerce—37th annual meeting, Washington, D. C., May 2-5.

National Fire Protection Association—53rd annual meeting, Fairmont Hotel, San Francisco, Calif., May 16-19.

National Industrial Service Association—Annual convention, St. Louis, Mo., June 6-8.

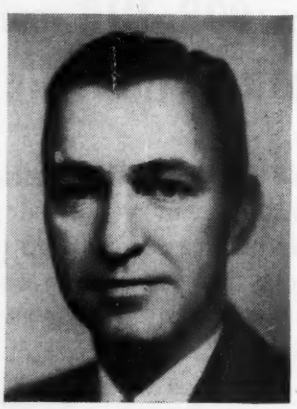
Illuminating Engineering Society — National Technical Conference, French Lick, Ind., September 19-23.

Manufacturers News

GENERAL ELECTRIC APPOINTMENTS

George G. Montgomery, a San Francisco corporation executive, has been elected a member of the board of directors of the General Electric Company.

Clarence C. Walker, formerly G-E commercial vice president assigned to customer relations work in the New England area, has been appointed gen-

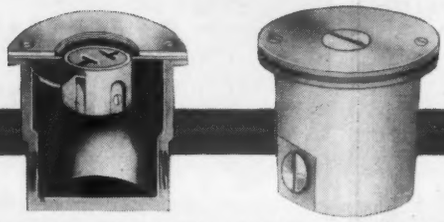


C. C. WALKER

eral manager of the Construction Materials Department. Mr. Walker, who will make his headquarters in Bridgeport, succeeds the late Carroll D. Hepler. He will be responsible for the development, manufacture and sale of wire and cable, wiring devices, accessory equipment and conduit products.

Appointments of F. Penn Holter, Charles R. Shields, Charles K. Skinner and Frederick V. Courtade to new po-

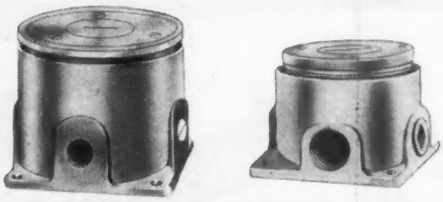
USE AUSTIN FLOOR BOXES and ACCESSORIES



WATERTIGHT NON-ADJUSTABLE BOXES

Completely assembled, including receptacle and nozzle. Cast body has three ½" holes in sides, two in bottom.

Complete for telephone or signal work, including cover plate and ½" flush plug. Does not include receptacle or nozzle.

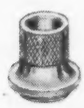


WATERTIGHT ADJUSTABLE BOXES

Deep Body Type. Completely assembled, including adjusting ring, cover plate with 2" opening, and flush plug. Maximum height 4½".

Shallow Body Type. Completely assembled, including adjusting ring, cover plate drilled and tapped for ½" standard pipe, and plug. Maximum height, 3¼".

BELL NOZZLE
2" diameter.



STEM NOZZLE
Tapped ½" standard pipe thread.

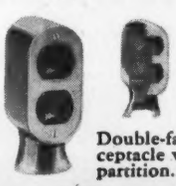
FLOOR NOZZLE

Oval duplex nozzle, complete with cover plate.

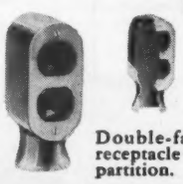
DOUBLE-FACED FLOOR RECEPTACLES

Base provides entrance for two ½" threaded conduit.

Double-faced receptacle with partition, finished in black fire-baked enamel.



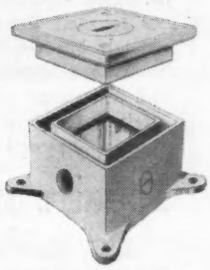
Double-faced receptacle without partition.



Double-faced receptacle with partition.

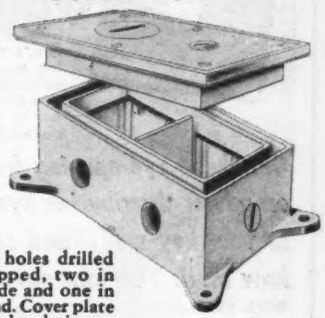
A Complete Line of High Quality Boxes for Telephone, Power and Lighting Outlets

SINGLE GANG ADJUSTABLE FLOOR OUTLET BOX



Four ½" holes drilled and tapped, one in each side. Cover plate with 2" opening for electric light and power. Also furnished with ½" opening for telephone and signal outlets.

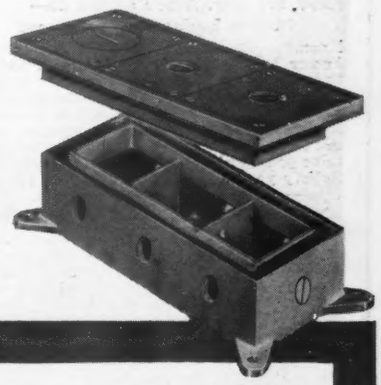
TWO-GANG ADJUSTABLE FLOOR OUTLET BOX



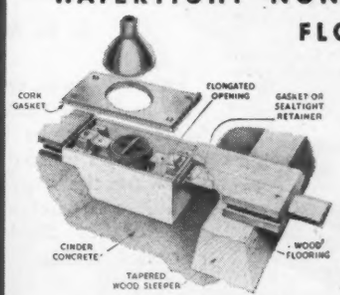
Six ½" holes drilled and tapped, two in each side and one in each end. Cover plate arranged to drain water outside of box. Cover plate with one 2" and one ½" opening, two 2" openings, or with two ½" openings.

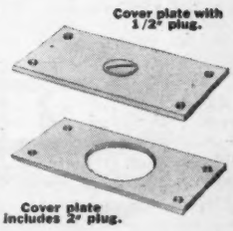
THREE-GANG ADJUSTABLE FLOOR OUTLET BOX

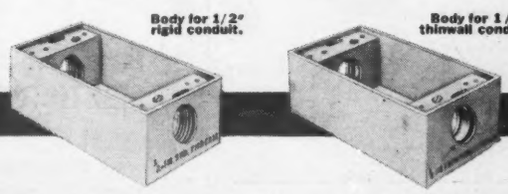
Furnished with three separate cover plates, two drilled and tapped to fit ½" standard pipe or stem nozzle. The third is drilled and tapped with 2" opening for plug or nozzles.



WATERTIGHT NON-ADJUSTABLE FLOOR OUTLETS







The M. B. Austin Company
NORTHBROOK, ILLINOIS

"WE SELL EXCLUSIVELY THROUGH WHOLESALERS"

sitions in the Construction Materials Department has been announced. Mr. Holter has been named assistant manager of manufacturing; Mr. Shields has been appointed manager of marketing service; Mr. Skinner has been appointed materials coordinator and Mr. Courtade becomes manufacturing engineer for the conduits products division.

Appointment of M. V. O'Brien as general sales manager of the Apparatus Department has been announced. He has been assistant general sales manager since December 1947, and will continue to direct the coordinated sales activity of the department's 16 product divisions through apparatus sales offices located throughout the country.

C. I. MacGuffie and R. C. Freeman have been appointed manager of sales and manager of engineering, respectively, of the Welding Divisions.

SQUARE D APPOINTMENT

L. G. Maechtlen has been named general sales manager of the Square D Company, Western Division. All western sales activities are now to be coordinated and directed by Mr. Maechtlen.

Following his graduation from Cal Tech in 1926, Mr. Maechtlen joined the

L. G. MAECHTLEN

company as an engineer. During World War II, as manager of the Los Angeles plant, he supervised production and sales in southern California. Following the war, he supervised design and construction of the new plant on Valley Boulevard, and has been works manager since its completion in 1946.

E. D. TILLSON JOINS LIGHTING PRODUCTS

Edwin D. Tillson has joined the staff of Lighting Products Inc., High Park, Ill. as consulting engineer. Mr. Tillson will work on new lighting equipment designs as well as lighting application problems.

Mr. Tillson recently retired as supervisor of the testing department of the Commonwealth Edison Co. in Chi-

THIS year's Christmas tree lights made by Noma will feature wire insulation made from GEON. They will be safer because the insulation is self-extinguishing in case of fire. The strings will be lighter weight, easier to handle because the insulation is thinner, smoother, more flexible, than old-fashioned insulation. They will last longer because the insulation resists wear, aging, heat, and flexing—won't ever get gummy, crack, or peel from the wire.

MODERN CHRISTMAS LIGHTS

Another interesting application for GEON raw materials

These properties, plus resistance to oils and greases, foods and chemicals, water, acids, mildew, sunlight, and most other normally destructive factors, have made versatile GEON the ideal material for literally hundreds of products in the home and in industry.

GEON can be pressure or injection molded, extruded, calendered or cast into sheet or film, applied as a coating to textiles, fibres, and papers. Products made from GEON may be brilliantly or delicately colored, flexible or rigid, clear or opaque. While we make no finished products from GEON, we'll be glad to work with you on special applications. Just write Dept. H-12, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. In Canada: Kitchener, Ontario.

Geon
Polyvinyl Materials
A TRADE MARK OF B. F. GOODRICH CHEMICAL COMPANY

Wire manufactured by The Ansonia Electrical Division of Noma Electric Corp.

B. F. Goodrich Chemical Company

A DIVISION OF THE B. F. GOODRICH COMPANY

GEON polyvinyl materials • HYCAR American rubber • KRISTON thermosetting resins • GOOD-RITE chemicals

E. D. TILLSON

cago. Technical director of the Chicago Lighting Institute since its inception in 1930, he has served for 32 years in the Illuminating Engineering Society as manager, secretary and chairman of the Chicago section, as director of the national society and on many of its technical committees. In 1945 he was elected a fellow of the society. He has also served on committees of the Electric Association of Chicago, International Commission on Illumination and Association of Edison Illuminating Companies.

NEW LIGHTOLIER VICE PRESIDENT

Theodore Berk has been elected a vice president and director of Lightolier, Inc., New York. Mr. Berk joined

T. BERK

the organization 26 years ago and for the past nine years has been assistant merchandise manager and Metropolitan sales manager of the lighting fixture division.

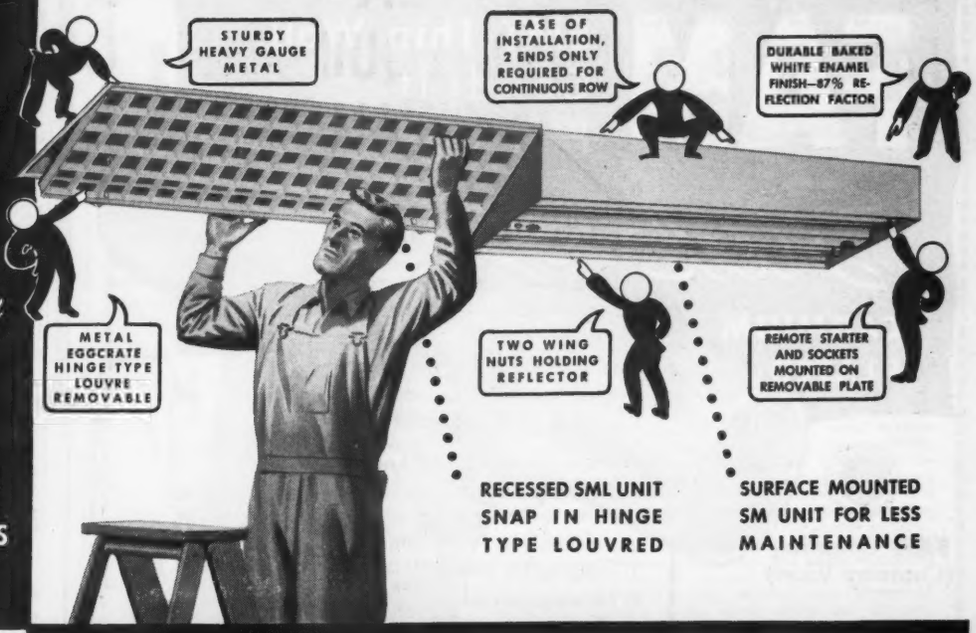
He is a member of the Illuminating Engineering Society.

WESTINGHOUSE CHANGES

Appointment of G. H. Grossnickle as manager of the Meter Division of the Westinghouse Electric Corporation, Newark, N. J. has been announced. In 1939 he was named manager of manu-

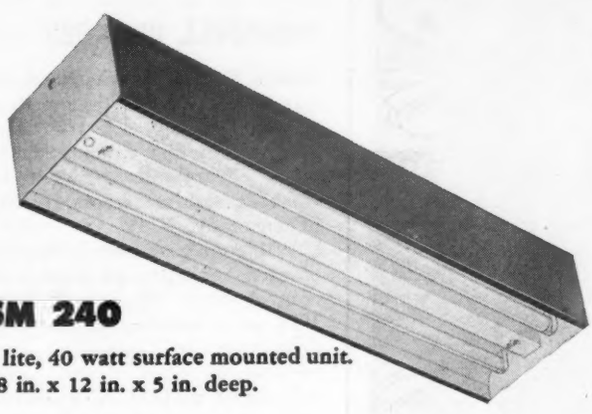
Get the MOST *for your money*

with All-bright's SM SERIES Surface and Recessed Fixtures



SM SERIES

A totally direct unit for high efficiency and low brightness, for surface or recess mounting, continuous runs or individually. Sturdily built, designed for eye-appeal and easy maintenance, with durable baked white enamel finish; reflection factor 87%.



SM 240

2 lite, 40 watt surface mounted unit.
48 in. x 12 in. x 5 in. deep.

REC SML 240

2 light, 40 watt recessed unit.
48 in. x 12 in. x 5 in. deep.

ASK ABOUT THE NEW BAY-LITE!

All-bright's sensational new louvred Bay-Lite includes the construction features of the SM Series fixture illustrated above, but is designed in units four and five ft. square.

The four ft. square unit is for use with from 8 to 12 40-watt T-12 fluorescent lamps.

The five ft. square unit is for use with six 40-watt T-17 instant start, low surface brightness lamps, or six 85-watt T-17 lamps.

Both units are provided with receptacle for insertion of swivel spoke focus spot light which is an integral part of the louver.

WRITE FOR ADDITIONAL DATA TODAY

There is only *one* manufacturer of All-bright fixtures. We have no affiliation with any other manufacturer of lighting fixtures. *Trademark Registered.*

ALL-BRIGHT ELECTRIC PRODUCTS COMPANY

Manufacturers of Fluorescent Lighting Fixtures

LIGHT RIGHT WITH All-bright

3917-25 N. Kedzie Ave., Chicago 18, Illinois

facturing which post he comes to his present position.

William A. Hayes has been appointed section manager in the Westinghouse electronic tube sales department, which handles X-ray tube sales and all electronic tube contracts with U. S. government agencies.

Frank Paeske has been named manager of miniature lamp sales at Bloomfield, N. J. He will coordinate the activities of the eight district offices with those of headquarters sales in connection with the sale of automotive lamps, flashlight lamps, Christmas tree lamps and other miniature types.

T. B. MOULE NAMED SALES MANAGER

Thomas B. Moule, formerly assistant director of sales, has been appointed sales manager of the Plomb Tool Company, Los Angeles, Calif.

Since joining the company in 1944, Mr. Moule has supervised many sales and merchandising activities. For five years following his graduation from the University of Michigan, he was advertising and sales promotion manager for Ex-Cell-O Corporation, Detroit. He served as sales and advertising counsel of clients for four years while account executive and new business manager of R. L. Wolfe & Associates. For three years he was sales manager of the Republic and the Northern Aircraft Products Dvisions of the Aviation Corporation.

TRUMBULL CHANGES

Yale T. Chaney has been appointed manager of distribution systems sales of the Trumbull Electric Mfg. Company, Plainville, Conn. He was formerly Trumbull's resident engineer, working with General Electric in Schenectady, N. Y.

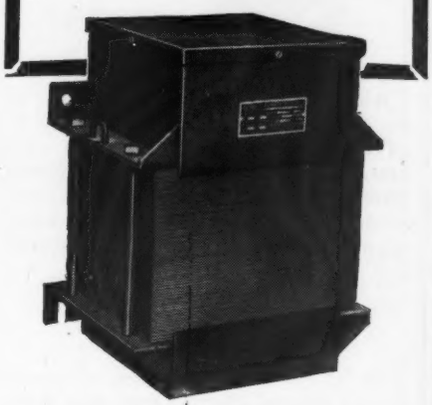
William A. Edwards has been appointed manager of switch, breaker, control sales. He joined Trumbull in 1924 as a member of the advertising department in Plainville. In 1942 he became manager of the Kansas City office and in 1943 he was the district sales manager of the Southwest district.

George H. Sahler has been named manager of marketing research. He was formerly market analyst with General Electric in Schenectady.

H. S. Hill has been appointed manager of the Trumbull office in Schenectady, N. Y. In this new assignment, Mr. Hill will be responsible for all Trumbull relations with the General Electric Co.

A. T. Allison has been named district manager of the Southeast sales district with offices at 700 West 5th Street, Charlotte, N. C.

AIR COOLED POWER TRANSFORMERS



Heavy duty design provides high efficiency performance at normal temperature rise of 55°C. All steel construction results in more KVA capacity per pound. Acme Electric air cooled transformers are built in sizes from 1/10 KVA to 50 KVA, primary voltages up to 600 volts. 1½ KVA to 25 KVA with primary of 2300 volts.

Use Acme Electric Air Cooled Transformers to

- ☐ Operate 115 volt equipment from power circuit
- ☐ Distribute power at high voltage
- ☐ Eliminate double wiring
- ☐ Provide 3 wire circuits
- ☐ Insulate circuit
- ☐ Boost voltage
- ☐ Balance voltage

Write for Bulletin E 160

ACME ELECTRIC CORPORATION
3612 WATER ST., CUBA, NEW YORK

Acme Electric also manufacture: Luminous Tube Transformers • Fluorescent Lamp Ballasts • Cold Cathode Lighting Transformers and Ballasts • Radio and Television Transformers • Electronic Transformers • Door Bell, Chime and Signaling Transformers • Voltage Regulating Transformers • Stepdown Transformers.

Acme Electric TRANSFORMERS

THE AMAZINGLY VERSATILE—MODEL 40

UTILITY TESTER

A NEW KIND OF INSTRUMENT FOR TESTING ALL ELECTRICAL CIRCUITS AND UTILITIES

- Thermostats
- Lamps
- Tubes
- Fluorescents
- All Fuses
- Condensers
- Field Coils
- Fans
- Heaters
- Washers
- Soldering Irons
- Melting Pots
- Air-Conditioners
- Ballasts
- Lighting Systems
- Electric Ovens
- Solenoids
- Circuit Breakers

THE MODEL 40 ALSO TESTS ALL MOTORS Single - phase, multi-phase, universal, squirrel cage, induction, in fact every type of motor from fractional H.P. to 2 H.P.

THE MODEL 40 UTILITY TESTER

Will indicate whether voltage is 110 Volts or 220 Volts, if current is A.C. or D.C. and if frequency is 25 cycles or 60 cycles. Will test Thermostats under actual working conditions. Will measure the actual current consumption of any appliance either A.C. or D.C. while the unit is in operation—reading will be direct in amperes—the appliance or utility may be plugged directly into front panel receptacle—a special pair of insulated clip-end leads is provided for motors. Incorporates an ultra-sensitive direct reading resistance range which will accurately measure all appliance and utility resistances down to a fraction of an ohm. Will test bulbs, fuses, condensers, field coils, etc. Is ideal trouble shooter as it will instantly locate opens, shorts and grounds. Will locate cause of failure in three-way heat control switches. Will indicate when one side of an appliance or motor connected to line under test is "grounded." Will indicate excessive leakage between a motor and a line. Will indicate when a three-phase motor is running erratically due to a "blown" fuse.

Model 40 Utility Tester comes housed in a rugged crackle finished steel cabinet with portable cover.

$15.75

Complete with all test leads and operating instructions

GENERAL ELECTRONIC DISTRIBUTING CO.
DEPT. EC-12, 98 PARK PLACE, NEW YORK 7, N. Y.

New **LIGHTWEIGHT ELECTRIC PLANT**

5000 WATTS D.C.

Weighs only 315 lbs.!

Model 5CK-115M, 5,000 watts, 115 volts D.C.

Use fast-working electrical tools on any construction or maintenance job with this high capacity, portable, compact electric plant. Equipped with four-receptacle box for direct plug-in of tools or lights. Available with carrying frame, or dolly-mounted. Powered by Onan 10 HP, two-cylinder, 4-cycle, air-cooled engine. Shipped complete . . . ready to go!

NEW ONAN "CK" ELECTRIC PLANTS are available in 5000 watts D.C., 115 and 230 volts; 2000 and 3000 watts A.C. in all standard voltages.
COMPLETE ELECTRIC PLANT LINE INCLUDES: A.C.—350 to 35,000 watts in all standard voltages and frequencies. D.C.—600 to 15,000 watts, 115 and 230 volts. Battery Chargers—500 to 6,000 watts, 6, 12, 24, 32 and 115 volts.
ONAN AIR-COOLED ENGINES—CK: 2-cylinder opposed, 10 HP. BH: 2-cylinder opposed, 5½ HP. IB: 1-cylinder, 3¼ HP.

Onan PRODUCTS

Write for catalog

D. W. ONAN & SONS INC.
2145 Royalston Ave., Minneapolis 5, Minn.

ONAN ELECTRIC PLANTS

Ideal Electric and Mfg. Company, Mansfield, Ohio, has named the Philadelphia Electrical and Machinery Company, as distributors in the Philadelphia area.

•

Cutler-Hammer, Inc. of Milwaukee has announced the opening of a new branch sales office located at 533 Mayo Building, Tulsa, Okla. B. R. Stratton has been named manager of this branch.

•

Announcement has been made of the appointment of H. L. Turner, Jr. as manager of the Shreveport, La. branch of the **Westinghouse Electric Supply Company.** Mr. Turner succeeds C. B. Wible, who has been made apparatus specialist for the Louisiana and Mississippi territory.

•

D. D. Pittman has been appointed by the **Illinois Electric Porcelain Company,** Macomb, Ill. as its sales representative in the states of Wisconsin, Minnesota and Iowa and the northern peninsula of Michigan.

•

General Controls Co. of Los Angeles, Calif. has announced the appointment of B. L. Lerch as factory branch manager of the new St. Louis office. O. D. Shaddox has been named factory branch manager of the new Oklahoma City office.

•

Black & Decker Mfg Co. announces that R. A. Wernsdorfer, service engineer at the Atlanta branch, has been transferred in the same capacity to the Baltimore branch. G. C. Wilhide, Jr. has been appointed service engineer in Atlanta to succeed Mr. Wernsdorfer.

•

William Brand and Company, 276 Fourth Avenue, New York, recently acquired the tubular braiding plant of the International Braid Company, which was located in Providence, R. I. This plant has been transferred to Fall River, Mass.

•

William Furber Smith, former engineering director of the "Manhattan Project", has joined the **United States Testing Company, Inc.,** Hoboken, N. J., to organize a new engineering inspection service in conjunction with building and building material.

WIRING FOR AUTOMOTIVE TESTING

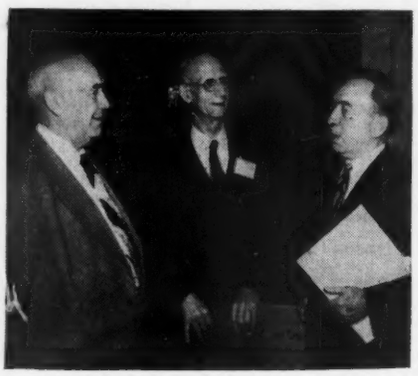
[FROM PAGE 68]

station switches are closed. Station operators know that fuel from that particular tank is not available. When tank loading is completed, the attendant closes switch S-M, and the valve may again be operated from any control station.

The wiring and control for a single valve is duplicated for all six valves, all supplied from the same 110-volt circuit. *Emergency switches are connected ahead of all other wiring. Operation of any emergency switch will shut off all fuel flow in the entire system.* All switches, except emergency ones, are rotary lock type, with tumbler locks that require key operation.

The electrical design provides the flexibility desired in an experimental laboratory. All conduits in the dynamometer system are oversize; spare conduits have been provided throughout, and additional conduits can easily be installed. *Conduit sleeves stubbed out of practically every power and lighting panel make it a simple matter to extend additional branch circuits.* Spare branch circuits, as well as space for future branches, have been provided throughout.

With very few exceptions, no fuel is exposed to the atmosphere, nor is there any possibility of its being exposed in normal operation. Hence, the installation is regarded as non-hazardous. Exceptions are the pit containing the solenoid-operated valves and the fuel weighing equipment where all electrical work is explosion-proof, Class I, Group D.



The importance of shielding high-voltage cables is stressed by Samuel J. Rosch (right), Manager, Insulated Products Development, Anaconda Wire and Cable Co. to J. S. Zebley, Chief of Inspection, Department of Buildings, Government of District of Columbia, and Walter E. Kern, Electrical Inspector, D. C. Government, at Eastern Section IAEI meeting.

COST FACTORS FOR CABLES

[FROM PAGE 64]

breakers for all distances over about 90 feet, individual circuit breakers are again the lower in cost.

The two examples which have been compared probably represent boundary extremes. Actual cases will probably fall between these examples; they do emphasize that large feeder circuits supplying a number of individual loads at several locations may not be economical. Better economy as well as potentially increased reliability may be obtained by sub-division into a greater number of smaller feeder circuits.

Typical Load Center Area

It will now be well to consider a typical factory area such as that shown in Fig. 23. This area, comprising about 100,000 sq. ft., is supplied by a unit substation with feeder circuit breakers and cable feeders supplying the individual load areas. In this case, the load center area is considered divided into 16 smaller areas each supplied by panelboard. Two typical cases are assumed:

Panelboard Rating	Unit Sub Rating	Volt amperes per square foot*
60 amperes	750	7.5
100 amperes	1000	10

* Based on substation rating

Cost estimates have been derived for both cases for circuit breakers and cables with four different arrangements for the feeder cables—with one, two, three, or four panelboards per circuit. Estimates were derived for both 15,000 and 25,000-ampere circuit breakers although a 15,000-ampere rating would be adequate for the unit substation size being considered providing cascade operation is considered acceptable. The cost comparisons are shown in Fig. 24.

It will be observed that for the 100-ampere panelboards supplied through 15,000-ampere circuit breakers it cost only one half as much to supply the load center area where two panelboards are supplied by one feeder circuit as where four panelboards are supplied by one feeder circuit. This represents a total saving of $9200 for this particular load center area. The saving is still striking even when 25,000-ampere circuit breakers are used, a saving of $7000. With 60-ampere panelboards a similar comparison is evident with the arrangement supplying four panelboards costing considerably more than where two panelboards are

supplied by one feeder. Here, the arrangement with three circuits is slightly lower in cost but better potential reliability, obtained by greater subdivision, would indicate the advisability of supplying only two of the panelboards from each circuit.

While the examples which have been shown are not sufficiently broad in scope to indicate that a specific cable rating will prove most economical in most cases or that a particular number of panelboards should be supplied from a single circuit, some general conclusion can be drawn.

Where 15,000-ampere interrupting capacity circuit breakers are adequate, every effort should be made to keep below the maximum 225-ampere rating available at this interrupting level. Above 225-amperes the circuit breakers are appreciably more costly and, in general, cable also will be more expensive since large portions of the cable run will be operated at less than rating as the cable extends from one load area to another to pick up sufficient load.

Even when 25,000-ampere interrupting rating circuit breakers are used so that the circuit breakers themselves are no more costly for higher current ratings (up to 600 amperes), it appears doubtful if a rating in excess of something in the order of 200-250 amperes will be justified unless the load is concentrated in a small area.

Further study may make more definite general rules in selection of feeder cable sizes possible. But in the meantime it is evident from the $9200 saving in one load area, which has been illustrated in the typical example used, that potential savings will justify the engineering time required to make an economic study of many applications.

Among Canadian electrical inspectors at the Denver meeting of the Western Section, IAEI were: (L to R) Renè Labelle, chief examiner, Board of examiners of Electricians; J. G. Benton and V. Rochonall of Montreal.

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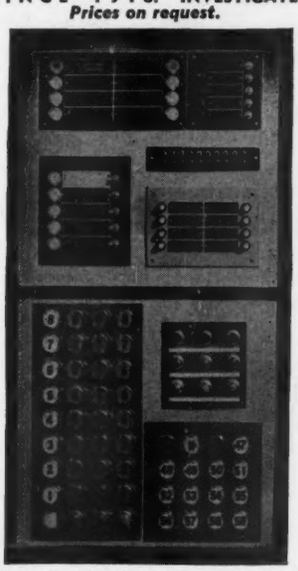

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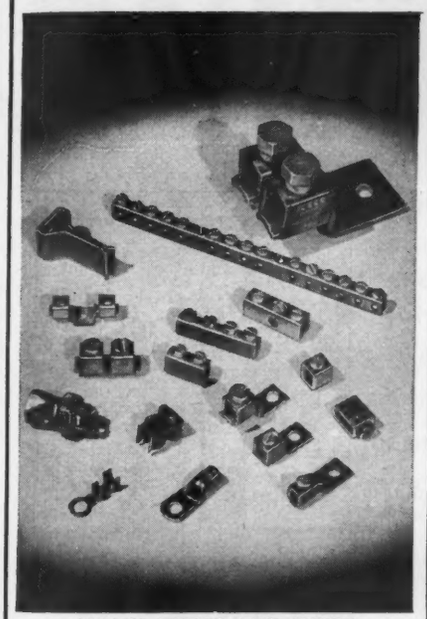

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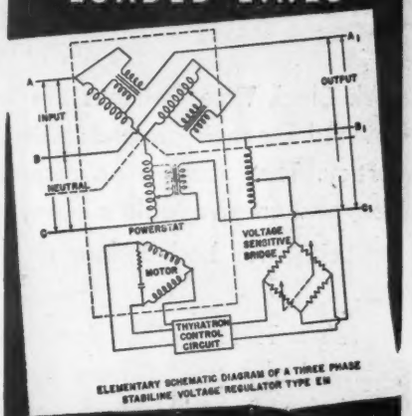

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SIGNAL POWER SUPPLY AND WIRING

[FROM PAGE 59]

be 24 would require nominally 12 cells at 2 volts each. However, it is best to select the number of cells on the basis of a discharged cell of 1.8 volts or a total of 13 cells. The latter provides proper operating voltage.

The source of current should be centrally located, so that the distance from the electrical center to the farthest signal will be held to a minimum. This will also permit the feeders to be distributed in different directions, reduce the voltage drop in the lines, and will produce a voltage at the signal device as closely as possible to the rating for which it was designed.

Selecting the proper wire sizes in signaling systems requires considerable care. In systems operating at the higher voltages such as 115 volts and 230 volts a-c or d-c, it is found that the usual sizes of conductors such as No. 14 and No. 12 gauge may be used. However, in the lower voltages such as 24 volts the size of the conductors is determined by the distance from the power supply to the farthest signal, and the total sum of the starting currents of all the signals which are to operate simultaneously. The accompanying charts in Figures 2 and 3 show the correct wire sizes for the 6 and the 24 volt systems. The charts are based on the originals developed by the Faraday Electric Corporation. Assuming that the system is to operate on 6 volts, and that the total load of the signal circuit is 10 amperes with the power supply 40 feet distant, accordingly No. 14 wire will be satisfactory. On the other hand it will be noted that in a 24 volt system the distance may be approximately 190 feet distant using the same size wire.

A lively post-luncheon huddle at Peoria meeting of Illinois Electrical Contractors engages (L to R) Wm. N. Cooper, manager, Southern Indiana Chapter, NECA, Evansville; and contractors Earl Weldon of Rockford and H. G. Roshto of Highland Park.

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